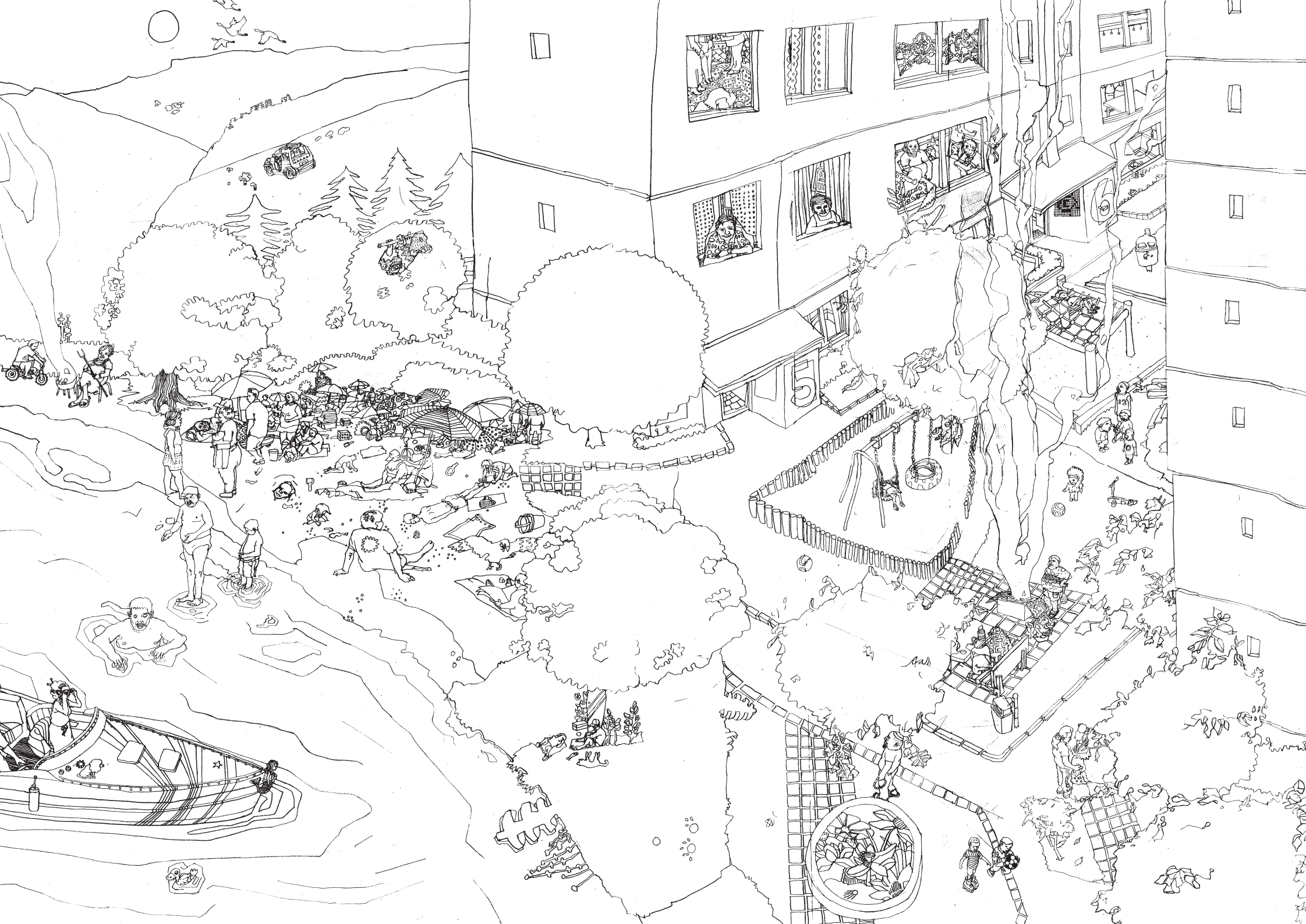
interLiving

Designing Interactive, Intergenerational
Interfaces for Living Together. IST-2000-26068
http://interliving.kth.se

Co-design and new technologies with family users

Deliverable 1.2 & 2.2

2002-09-24



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interLiving deliverable D1.2 & 2.2

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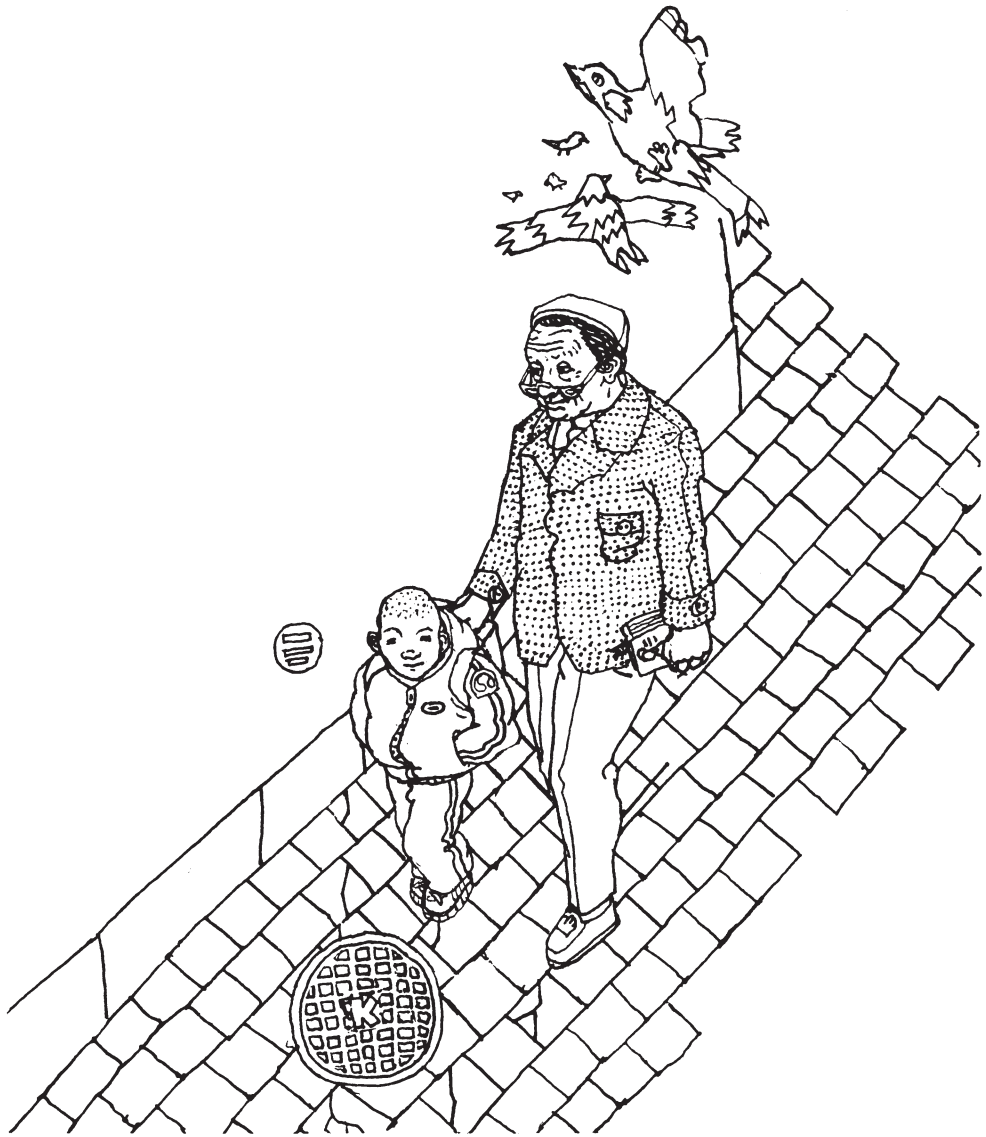


Introduction

This is the second year deliverable from the interLiving project, “Designing Interactive, Intergenerational Interfaces for Living Together”, within the EU FET Disappearing Computer initiative. Partners come from CID/KTH (coordinator) in Stockholm, INRIA in Paris and LRI/Université de Paris-Sud.

Integrated report

In the interLiving project the research process is strongly cooperative and multidisciplinary with participants with backgrounds in anthropology/ethnography, computer science, graphic design, industrial design and pedagogy. This cooperation has become very strong as a natural way of working in the project and that should be expressed also in the account of the experiences and achievements of the project.

Thus we have chosen to “melt” the originally planned two deliverables/reports, *D1.2 Co-design* and *D2.2 New technologies with users*, into this integrated report, *D1.2&2.2 Co-design and new technologies with family users*.

This written report is accompanied by video material.

Contents

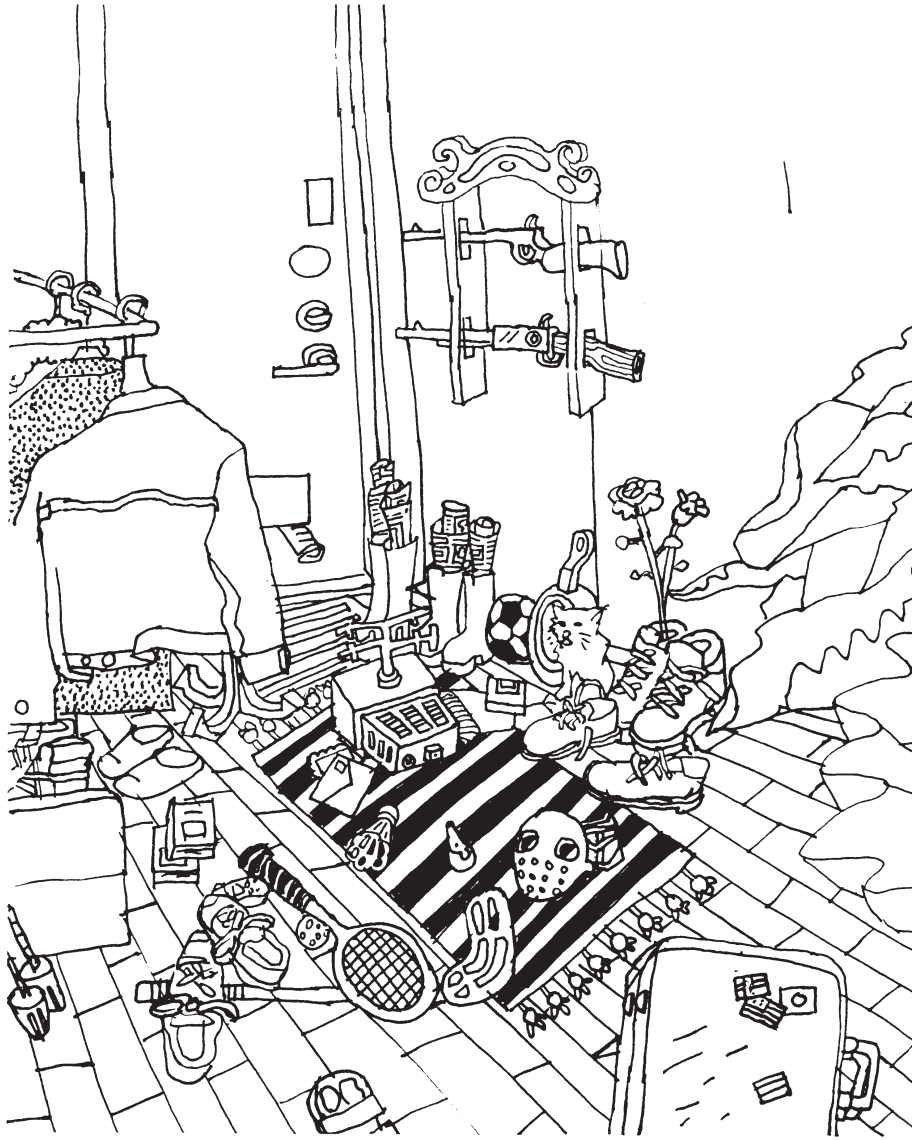
The first chapter is about the work with our design partners; the families in France and Sweden. By showing examples from our different meetings and ways of working with the family members, a picture is given of who they are and how we have worked together.

The second chapter is about Technology Probes, which are a set of easy-to-use, distributed shared surface technologies that we installed in the households of the family, to understand how technology is used in a real world setting and to inspire users and designers to new ideas.

The third chapter is about Prototypes, which are used in a cooperative iterative design with the families. Two types of prototypes are presented; a FamilyNet, that will let family members establish and reconfigure small-scale, secure networks, and different distributed shared surfaces.

In the fourth chapter we give accounts of experience and results from cooperation with other Disappearing Computer projects and a general audience of researchers: an “atelier” with the ACCORD and MiME projects consisting of two two-day workshops in Cambridge and Stockholm, a workshop with e-Gadgets and FICOM in London, and an “Interactive Thread” for three days at the DIS conference in London.

In the fifth and last chapter ideas and outlines for how to continue the work into the final period (15 months) of interLiving are presented.



1 Working with families as design partners

Different ways of getting information

We have tried many different ways of getting information from and about the families as well as the individuals within them. At first we focused on understanding the whole family and therefore gathered all the households for workshops in our labs. It had several purposes on several levels.

It was important for the family members to have met the other families. It could make us talk about the others opinions, compare and give input to discussions. They all would have something to relate to.

We gave them the same tasks during the workshops and they conceived and finished them differently. They (and we) became aware of their similarities and differences between the families as a group.

But these exercises clearly showed us that we could not get hold of the individuals' or even the households' feelings or thoughts about family communication. During these big workshops we received the "official" understanding of the family and its members. We got the "official" story of family life.

Visiting the households made it very obvious that the goals, needs, responsibilities, interests, etc. of the individuals differed considerably. It was also clear that the parents' opinions often were dominating in the discussions.

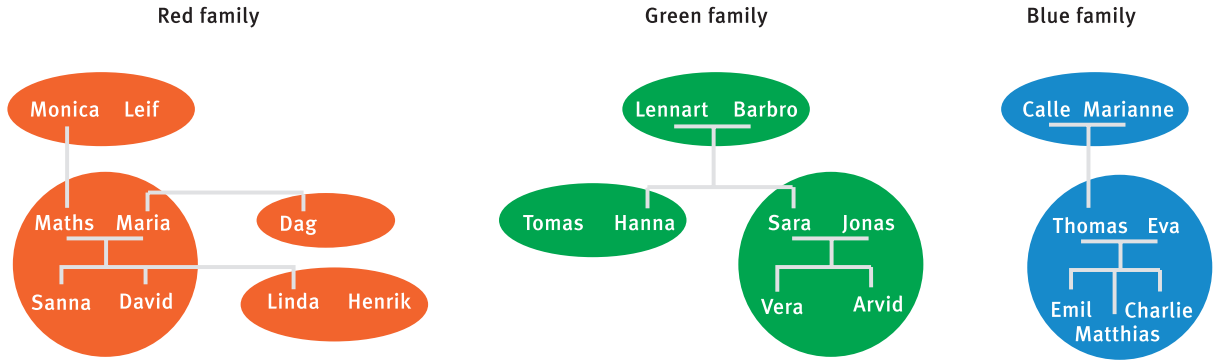


Figure 1.0.1 In deliverable D1.1 it was a bit problematic to keep the family members incognito without using any names and still write about their lives. They were often named after their relations to each other, but a grandmother can also be a mother and a sister, so there was a lot of confusion. We had serious discussions about that. Should we give them numbers? Of course not. They are individuals living in families, they are not a test panel. Should we give them other names? Well, we could. But a name is a very important part of yourself. Names also reflect in what time you are born. After many discussions of how to deal with this, we asked them to give themselves nicknames and to stick with the colour surname we had already chosen for them. We hope that this will make it easier to read this text.

The lines: *reflect bloodlines or connections between parents.*

The ellipses & circles: *Household border. Besides the names inside the line there may be other persons living in the household as well.*

The names: *Fake name of the person participating in the project.*

1.1 Users, partners and informants

Family description

The family members have chosen their own nicknames, and have the colour surname we have chosen for them. This means that all family members in one family have the same surname.

We are very aware of that we cannot consider our group as a statistically relevant subgroup of Europeans. All the (Swedish) households with children are "traditional", i.e. the biological parents live together with their children. But this is still rather common. In Sweden 75% of all children 1-17 years of age live together with both of their biological parents (*Demografiska rapporter 2000:2*. Barn och deras familjer 1999).

Families change

All the families have changed, in one way or an other. Everyone grows older, for example. That's very obvious when looking at children. Their abilities improve a lot when they go from 9 months to 1 year and 9 months, as in Arvid Green's case. When we first met him he was just a baby. He slept a lot and sat in his pram or in someone's lap most of the time. He managed to smash a glass bowl full of sweets down on the floor at a workshop, but apart from that he did not do much design work. Now when he is almost two years old, wild and happy, he has already given us design input like; Attach important technology together that by necessity goes together or else I'll hide it, and Make it possible to use two pens simultaneously to draw on the screen, or else my sister and I just fight. (Message Probe, spring 2002).

It is not just age that improves your abilities and behaviour. Barbro Green, the grandmother of Arvid, said when we first got to know her, about 18 months ago, that her daughters had sent her SMS text messages with their mobile phones, but she never replied because she did not know how to and she did not bother. Recently she told us that when she was on vacation on Sicily she sent both her daughters SMS messages, telling them how fantastic the experience was. She did not want to disturb them in their work or feeding children or whatever they were doing. But she wanted to express her feelings when she felt like it. She found that this is a good thing with sending SMS messages, instead of phoning someone. If she had phoned and the one answering had been occupied Barbro would have been disturbed herself by that. She did not want to be taken out of her experience there on Sicily. (Jan 26, 2002). So not only had she learned HOW to send SMS technically, she also had developed a strategy for WHEN and WHY the technology could best be used to suit her needs.

Other things change too. Linda, one of the daughters in the Red family, who lived and studied

in a town about 2h 30 min from Stockholm, has now moved in with her boyfriend in Stockholm. Thomas and Hanna Green, who live in a two room flat in the town of Stockholm, are about to move out from the city to a newly built house in the countryside, closer to Hanna's parents. For interLiving, this means that we do not have that household in another town. Instead we have a new interLiving family member, Henrik Red. That is life, and these continuously changing circumstances are one aspect of life in families and interLiving. One of the basic underlying forces in many families is change.

Technology should allow for and support peoples changes of abilities and needs. It is not necessarily the same technology, the same artefact, that should allow for and support peoples changes of abilities and needs.

The relation between researchers and family members

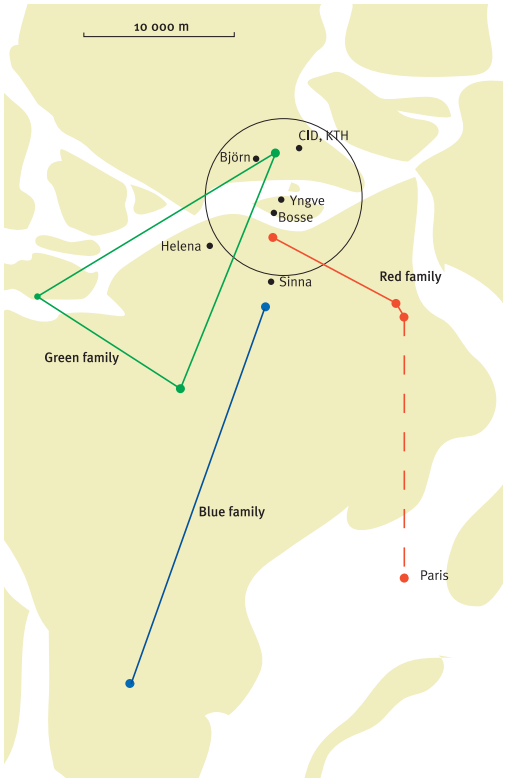
Even the relations between researchers and family members have changed, simply because we know each other better. For example, the ways we communicate with the family members are more diverse. Calle and Marianne Blue are retired from work and live with their old dog and spend most of their time at home and at their summerhouse in the archipelago. They have no computer but a mobile phone, that they received from their children and which they never use. The easiest way to get hold of them is simply to phone their home number. Or if

Fig 1.1.1

French and Swedish families together with researchers at the joint workshop in Paris May 4. The location was the Maison de la Mutualité.

Figure 1.1.2
The rough location of the different households of the three Stockholm families, the researchers home and CID, the research lab.

The circle has a radious of about 5 km from the center of the city.



it is not that urgent or perhaps more formal, send them a letter.

Another example is when we were going to set a date for a meeting with two of the Green households. They had tried the Message probe for some time and we wanted to gather their reflections and ideas on the usage. This was in the middle of the Swedish summer holiday and there was a big risk that no one would read e-mail.(July 2, 2002) But Sinna took the chance to send an e-mail to Sara and Hanna anyway. Sara replyed fairly quickly and was positive about the time for the scheduled meeting. She told Sinna to send an SMS to Hanna since they were on vacation and wouldn't read e-mail. So she did, and received a reply about 10 minutes later: "I think we can. Right now we're sitting below an impressive glacier in Norway and have no total control over "ordinary" life. Will check calendars. H and T". (Vi tror att vi kan. Just nu sitter vi nedanför en mäktig glaciär i Norge o har inte full kontroll över det "vanliga" livet. Ska kolla kalendrar. H o T).

The two examples show how we, researchers have to be selective in what media we use for different kinds of messages. But also sensitive to what is the most familiar or easiest way to keep in touch with family participants. This is not a revolutionary discovery, but it shows well one way of breaking barriers and building trust between researchers and families in a participatory design project. The "give and take" and "loosen up formal language" in a conversation is important for being able to say what you really think and want. The invitation of building trust can come from both parts, and it is a step by step procedure.

Another example of how the relations have changed and grown deeper is that it is easier now, at least for some of the family members, to be very clear in their opinion about things we, the researchers, have designed. Like Thomas Green's comments on the Video probe box: -"It's so big and ugly. It really sucks! Why can't things be made with a 50's or 60's touch?" (July 22, 2002, 18.00 – 20.00). Or Hanna Greens comments on the frame of the Message probe screen: -"Why do we need that? No, don't put it on. This boring computer grey is really too much. It's much cooler with this dark technology frame. Fits with our new loudspeakers." (May 29 2002, 18.00-18.45). It's honest and straightforward in a manner that wasn't quite there before.

The connections between all of us have grown deeper. There is an interest, from the family members' side, in knowing what people we, the researchers, are. We have several examples of how our family members ask us about our own families, how our vacation was or if we work all the time. Of course, these questions are usually ordinary conversation starters. But bit by bit, everyone gets to know almost the same things about each other. Here is one example: One Sunday evening in spring I went on my bike to pick up a DV-camera at Calle and Marianne Blues' house (April 28, 2002). Marianne anxiously wondered if I left my kids at home alone? I replied honestly, but in an ironical way that, yes and a PC-game is the most suitable babysitter, and we both laughed. –"They will proba-

bly not even notice that I'm gone. Heroes of Might and Magic sucks them into another dimension!" That conversation started a discussion about her grandchildren who sit by the computer far too much and play far too many violent games, according to her. On the other hand, she reasoned, they learn a lot about how to use computers. Computers become part of their daily life in a natural way, and she compared with herself who doesn't know anything about computers.

This conversation is not much. In fact all the examples above are not much to talk about, but it shows the change in life and the variety of how we communicate. When we know each other better we can go from official and polite language in every situation to a more informal language when it suits us best.

This is important when we talk about users in the family. Looking at these users explicitly we have to look for other things as their common goal or interest. Productivity or efficiency in family life might be important, but not in the same sense as for users in work places. One could say that they have routines in common; like going to school, cleaning, making dinner, picking the mail up etc. But looking closely at these routines, they are not conducted the same way in either of the families.

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1.2 Work with families in their homes

Figure 1.2.1:
Cut from the childrens video assignments. Playing games on the computer was mentioned on almost every video.

To get everyone involved in the Project

It is not easy to make all family members actually participate in the project work, to do participatory design. All family members did not participate for the same reason. Marianne and Calle Blue explicitly said that they participated because their sons family asked them. Since they have retired and have the time they wanted to participate. But before they entered interLiving Calle was a bit concerned that participating required knowledge about computers and the Internet. He and his wife have never used computers, not even at work. We have also initiated smaller projects like letting the kids make movies of different parts of their daily routines. We have let the oldest generation film any of their interests (photo collecting etc).

Workshops are clearly not always the best way to get hold of the individual participants preferences and ideas. Therefore we conducted a series of individual or pair interviews. This worked very well for the grown ups but we still wanted to get more input from the children.

Photo and video assignments

It was clear that we needed a better way of better letting the children and grandparents express themselves apart from the parents . To do this, we gave them photo and video “assignments” as communication probes (see 2 Technology Probes section for details about probes).

The communication probes that we used gave us insight into the families. But they also taught us that giving the same kind of probe to the whole family, will give one or perhaps two persons view of family life. Writing a diary is a rather grown up thing to do, while drawing a diary, or telling by taking Polaroid photos, is easier if you are younger. This insight made us produce probes targeted to just a few persons, to focus on the individual. We have spent a lot of time considering how to make each person be seen in the process.

To Vera and Arvid Green, the two smallest children, we have tried to make the probes as easy as possible. With easy, we mean easy for them to handle and relate to. We gave them a Polaroid camera, to share, to take pictures of things you want to show to someone in your family. Then they put the photos in a personal photo album. Their parents annotated them with the children’s stories.

The older children in the Red and Blue families, 7-14 years old, were lent a simple digital video camera with the assignment to: Describe everyday activities to somebody from outer space, that understands your language.

This way we achieved two different things, both more interest in the project and a better understanding of the children’s everyday life.

Vera used to be shy when she met us but now she greets us with a big smile and tells us what she has been up to without hesitation. The other children have been active all along, but we guess that this makes them keep the interest up, since they became more visible through the movies. They all really had fun doing the movies.

The children showed us mostly their life in the afternoon, after school but before the parents came home. The movies contained sporting, TV watching, playing games on the computer, fighting with your brothers, friends, roller-blade skating to school, skateboarding, telephoning, listening to music, etc. And also two of the kids showed how they clean up their room and the basement. That really surprised the parents. We also got glimpses of a father's hair cut, breakfast, toilet. All these bits and pieces add to our understanding of the individuals and the families as a whole.

We also gave some grandparents an assignment to capture their view on taking and collecting photos, but they have not dared to use the video camera yet.

Things change and appearance matters

One advantage of visiting the same households over a longer period of time is that we can observe how households change. People buy new stuff, old stuff is moved around or thrown away.

One example where appearance is important is at Barbro and Lennart Green's house. A year ago they showed us their portable telephone as an example of an ugly product that they did not like.

At a recent visit they had just bought a new one. They thought that it was much nicer than the previous one and that this was the most important reason for changing. The old one still worked but they had convinced themselves that the quality of the sound wasn't good enough. They could not buy a new one only because of appearance, but almost.

When describing how the choice was made it was clear that sound quality, character, operating time, colour, etc all were considered at the same time. The product was seen as a whole.

Figure 1.2.2(top):
M: –Now we'll see when mom is cocking, and she does that in the kitchen. (...)
When Eva saw the movie she said "I never cook!"
Cut from the childrens video assignemnts.

Figure 1.2.3 (bottom)
Three brothers fighting/playing.From the childrens video assignemnts.

Figure 1.2.4 (top)

Vera Green describing her Polariod photos to Sinna and Bosse.

Figure 1.2.5 & 1.2.6 (bottom)
Two of Arvid Green's Polaroid photos.

"Picture to show mommy because I can't do that". (left)

"Favourite toy." (right)

1.3 Workshops with families

Development of the themes for /results of the workshops

The themes and ways of working have evolved through the series of workshops we held together with the families. First we were sort of quiet and careful, trying to grasp the essence of each family. But now we are pushing a lot harder.

Summer memory workshop

The set up of the Summer memory workshop in Sweden was a reaction from the researchers on the result from the previous one where the results were interpreted as machines for control and not as innovative as we hoped for. Except for the BongoFax that can be seen as an "escape machine". (inteLiving Deliverable 1.2)

At the time of the workshop, September 2001, we were focusing towards a more personal approach and were also later encouraged by our reviewers to do so. Our hopes were to get to know the needs and desires of the children and grandparents better. We had also seen some structures of power within the families and we wanted to split the participants into groups according to age instead of family relations. The four groups were children under 12, men, women and grandparents.

First we looked at the summer memories that all households and we researchers had collected during the summer in cardboard boxes. Everyone opened their box and presented the contents in a relaxed tempo. Stones were the most common things, but also tickets and tools for fixing houses.

Next we broke into the four groups. The task was to try to summarize the summer memory content into relevant aspects/groups. The idea behind this was to see what interests seem important to people. This would hopefully be revealed in the categorisation.

The grandparents had tons of older memory to draw on. Marianne Blue told us about how a complete stranger surprisingly attracted her attention. Later she realised that he used the same after shave as her husband, Calle. (Figure 1.3.3)

The grandparents also made it very clear that it was the grandchildren that they wanted contact with, not so much the generation "in between". The fathers also expressed the importance of the contact between those generations.

One very common opinion was that it was very important to spend time together with the people you are closest to. And that seems to be what our families do during the summer: Gather with relatives and friends.

The next step was to build a "Summer Memory Collector" from the usual arty props, based on the categorisations made earlier. The groups also

Figure 1.3.1 & 1.3.2
Some of the artifacts that acted as summer memories.

1.3.3

1.3.4

1.3.5

developed scenarios showing the use of the "collections".

Our hope was that this would be a very difficult-task and therefore would be a lot of fun and that it would release a lot of creativity. What we hoped to find out was: What is important to remember? What influences us? What has meaning to us? How do we want to cope with these memories? What makes a difference?

One interesting difference between the women's and the men's groups was that the men started out by asking themselves how much time they had and in which way they should present the results. The women started out by saying: "Why should we make something like that?"

The idea mock-ups were described and the scenarios were more told than acted out. There was a big difference among the groups. The grandparents made a multisense machine that helped trigger all senses with a special focus on smell.

One of the men said that recording "memorable moments" is something that parents do. When you are a kid you do not care. But now as we grow up we are doing the same as our parents did.
– "A video of for example our son's first steps is totally uninteresting for somebody outside the family." This is a good example of how opinions and focus change over age/role/context, and therefore also within a family.

The children regarded memories as something that should be used in the present. Scars and trophies are really good for bragging, to take one example (figure *1.3.4*).

The men made a bunch of different stuff (example in figure *1.3.5*) and the women suggested that we should all live in the present instead. "Carpe Diem", sieze the day.

DOMINATION, POWER

Both parents and researchers can dominate and "run over" other people. This was obvious in some workshop presentations. One father pulled the low-tech prototype out of his daughters boyfriends hands and started presenting it himself.

More serious is that one researcher began presenting the work of the children instead of letting them present it themselves. The children have presented at other occasions so that is normally not a problem.

January workshop

The second workshop for the French families was held in January 2001. After asking participants to give examples of communication situations, we introduced the notion of "shared surfaces", which was the focus of this workshop. The video probe and the message probe were shown as examples of possible shared surfaces. In the next exercise, the participants were asked to give scenarios of use of those two probes, grounded in their own daily life i.e. using the communication situations they had listed before. In the next exercise, they were asked to come up with ideas for other types of shared surfaces, and to use low-tech prototyping to visualize their ideas via models made out of shoe boxes,

coloured paper, magazines clipping, wool, wooden sticks etc. Finally we discussed the possible form of the next meetings.

The notion of "shared surfaces" was presented in layman terms as "something that helps our senses (sight, hearing, touch etc.) to communicate with someone who is away". Shared surfaces could be small – large – enormous, fixed or portable, using all senses, interactive or not, showing something concrete or abstract, one way or two way. Those dimensions were summarized on a whiteboard for future reference, and many examples were given, practical ones and blue-sky ones.

In the discussion following a demo of the two probes, both Pierre and Marie-Lise Violet questioned them. What were the implications of the topology of the probes square and flat? What could the probes accomplish that the Internet is not capable of already? Picking up the cues from the introduction they started to ponder about shared surfaces using audio or tactile information.

Pierre thinks about the air as a shared surface: When you enter a room you can register the mood of another person who is in the room.

The model they built represents a house with three rooms. In the first room there is a large kind of soft sculpture. It is a surface for tactile communication: the visitor touches and squeezes the thing to receive and send information. Perhaps the girls intended the sculpture for conveying emotional closeness and attention, not for conveying factual information. One room has sensors on the walls

Figure 1.3.6 (top):
The groups presented their prototypes.

Figure 1.3.7 (bottom left) :
This prototype was to suggest that wearing a special bracelet would send preselected photos to the parents. So when away from the parents, the children could decide what bracelet to wear to tell their parents if they felt good that day or not. The parents would just see a photo change when the kids mood changed.

Figures 1.3.8 & 1.3.9 (right):
Models with shared surfaces using audio and tactile information. Among other media, air was used.

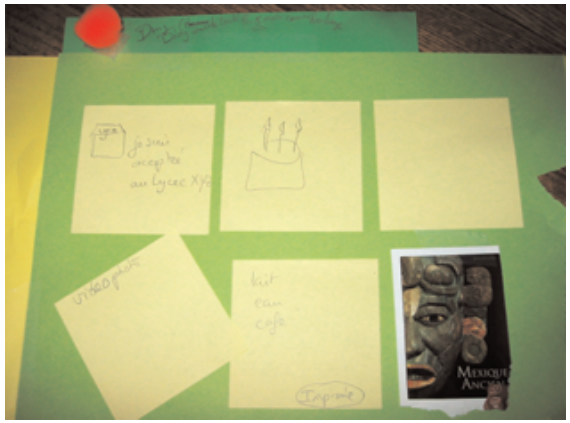
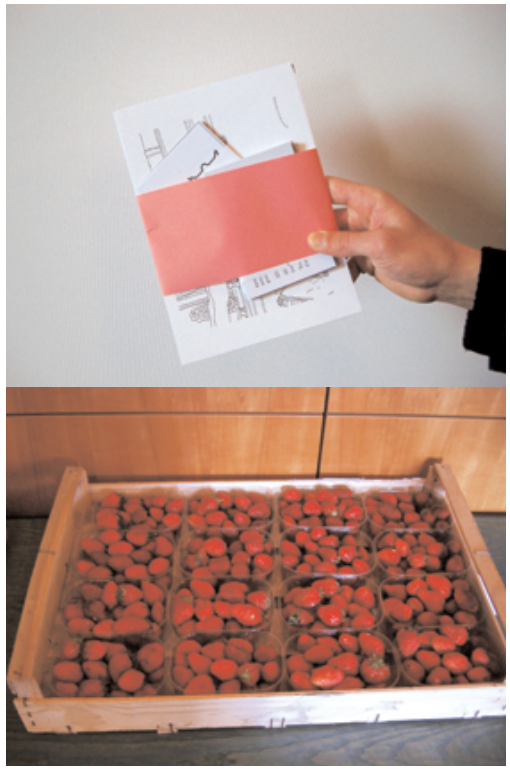


Figure 1.3.10 (top)
The material that the groups started with was packaged in this way to show them that we take this serious.

Figure 1.3.11 (bottom)
Besides the material necessary for direct work the preparations also include strawberrys, drinks, etc.



and on the floor to sense how you move in it. (see figures 1.3.8 and 1.3.9)

Joint workshop in May

In order to decide what ideas should be developed further we arranged a joint workshop in Paris together with both the French and the Swedish families. We wanted the family members to influence the decision of what prototypes should be developed in the interLiving project.

We were interested in understanding what would make sense to some of the people. We had collected lots of bits and pieces, mostly text and artefacts. We chose to use quotes from all the different meetings we had had so far. Of course we made a selection that we believed showed the range of interests that had been expressed so far throughout the interLiving project.

We compiled a list of quotes from the family members that we thought reflected their different needs and desires.

We designed “needs and desire cards” but thought that they were not inspiring enough and since there was only text on them they all looked very similar. We contacted an illustrator to make illustrations that reflected the around 17 different groups of quotes. We chose an illustrator, Henrik Färlin, with a style that we thought reflected the state the project was in. The drawings would be full of details. This is in contrast to the more cautious and elegant character of illustrations that we had used in the first deliverable.

The illustrations made were very inspiring (see figures 1.3.12, 1.3.13 and before of each chapter for some examples).

After several rounds of discussion and sketching on how to set up the workshop we ended up just giving the families the illustrations to work around without the quotes attached.

We realized that the illustrations actually could be seen as an analysis of the quotes The visualisation transformed the information into another medium that permitted new interpretations.

USE SCENARIOS

We broke everybody into seven groups regardless of language: small children, younger boys, older girls, young adults, men, women and grandparents. The groups were to choose one of the 17 illustrations and make scenarios that reflect something real and recent of importance for themselves. The groups should discuss and decide on:

- What just happened in the picture.
- What they would like to do in the picture.
- Pick something in the picture and augment it.
- Imagine what you could do with that.

The faciliators in the groups had several prepared questions to throw out if the discussions did not feel fruitful. Everybody was encouraged to be detailed and “Show and tell” their scenarios.

One example is the illustration with the letterbox, (figure 1.3.12). where the tire tracks were interpreted as bypassing information and the letterbox itself would filter out the relevant pieces. After some discussion everyone in the group decided that the letterbox should be augmented with air.

In a previous French workshop (the January workshop described above) one family had developed a room where air was one of the main components (see figure 1.3.8). Here Marie Lise Violet reused air as a medium for communicating. So it was partly a reuse of that, rather unusual, medium. This is one example of pieces that survive and build bridges from one workshop to another.

SHOW AND TELL

The groups presented the use scenarios, the ideas and simple mock-ups for all the other groups.

DESIGN SCENARIOS

The groups picked a mock up and chose a scenario. Then they developed both the scenario and the mock-up so that they fit each other better.

The resulting ideas from the young adults group were several ways of keeping "background" contact of feeling of presence and also one more focused on the moods of the different people connected. Most of the ideas ended up as having/needing two parts because we all wanted to show things that actually could "work". But one scenario was more elaborate and had six people involved in a decision about what to do Friday night. There was also a lot of discussions about integrity. You do not want to reveal your "state" just like that to other people. Definitely not to people outside of your family but even within. You must know what "it" transmits (and to whom as well).

VIDEO PROTOTYPING

All groups were asked to act out their design scenario with the help of the mock-ups in front of video cameras.

Among the ideas that were presented the grandparents were concerned with protecting and tracking grandchildren with wearable sensors. And the parents could track to see that grandpa had picked up a child at daycare. The young adults were interested in discrete devices for sharing feelings with friends and the sisters' mates – jewelry that blows air signifying a message from a boyfriend or decorative boxes that show the mood of their friends by making waves in a pool of water. The kids wanted small devices for keeping in touch with friends and parents – voice activated key chains for sending messages and watches for checking calendars for after school activities.

Most ideas fell into three broad categories: communication, coordination, and presence. All these can be regarded as peripherals that add on to a FamilyNet, a closed network that affords control, trust and integrity. (More in chapter 3 Prototypes.)

COLLABORATION ACROSS LANGUAGE

One of the most wonderful experiences from this workshop was how well the groups worked together across language barriers. All groups, including the children's, worked together with the help of mixtures of gestures, English, Swedish and French. Everybody was engaged in the discussions, development of the scenarios and building the mock-ups. Some differences between the groups were obvious. The fathers talked more than they built and the kids built more than they talked. The kids developed most ideas in spite of, or perhaps thanks to, that they took a long break and played football outside.

Figure 1.3.12
One of Henrik Färlin's illustrations meant to trigger the work with shared surfaces.

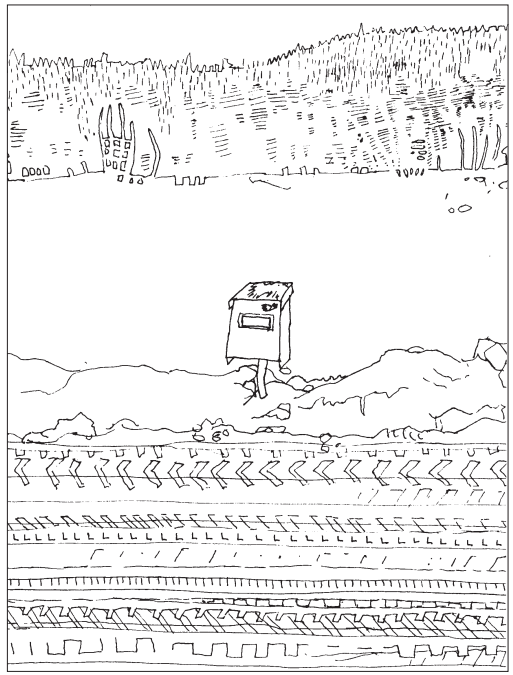


Figure 1.3.13
One of Henrik Färlin's illustrations meant to trigger the work with shared surfaces.

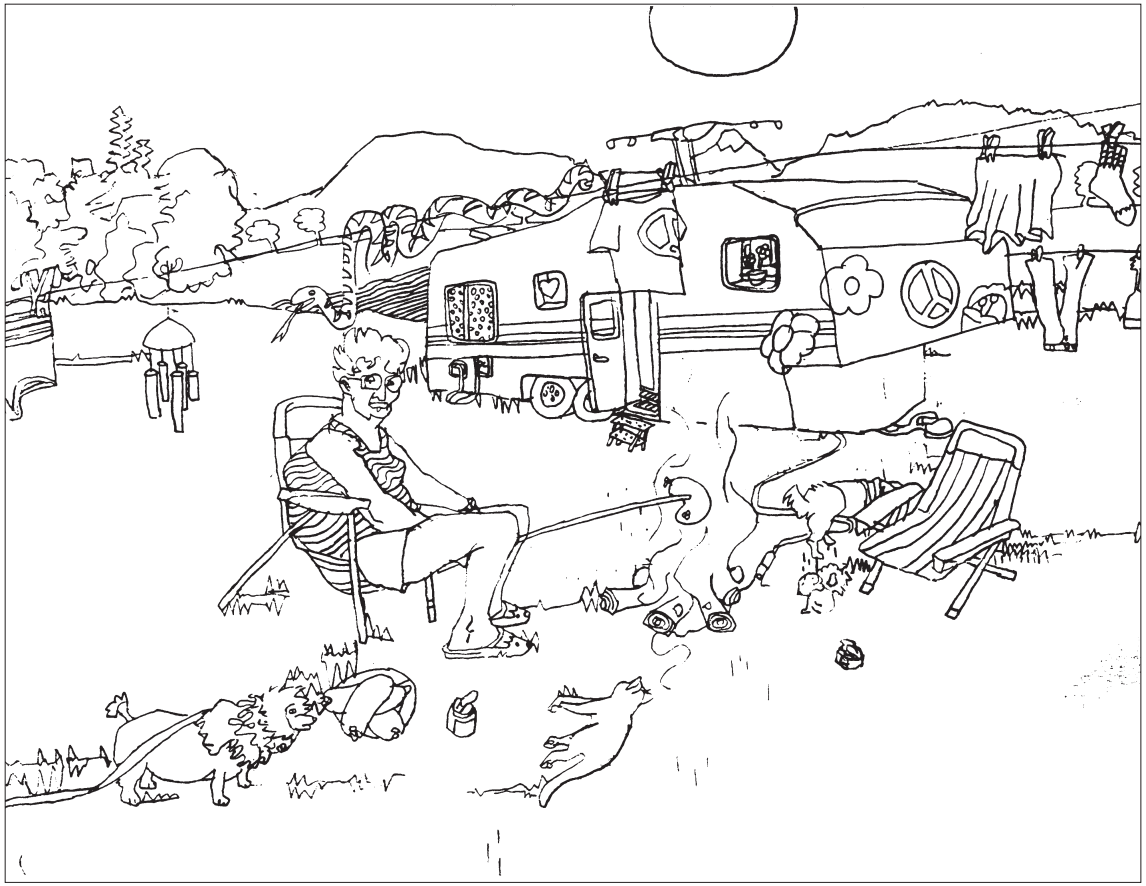


Figure 1.3.14 (top)
A mock-up of devices for staying in touch through puffs of air.

Figure 1.3.15 (bottom)
The women showed mock-ups of coordination devices for keeping track of the rest of the family.

1.4 Use experience of technology probes

Family use of the messageProbe in Sweden

INSTALLATION

The first implementation of the messageProbe was in family Red. All households in the Red family live, and lived, in areas where some sort of broadband access is available, which is a requirement for the messageProbe to work as smoothly as possible. The messageProbe itself is described in 2.2.

The probe was first installed at Monica and Leif Red and the same evening, we started the installation in nuclear family Red.

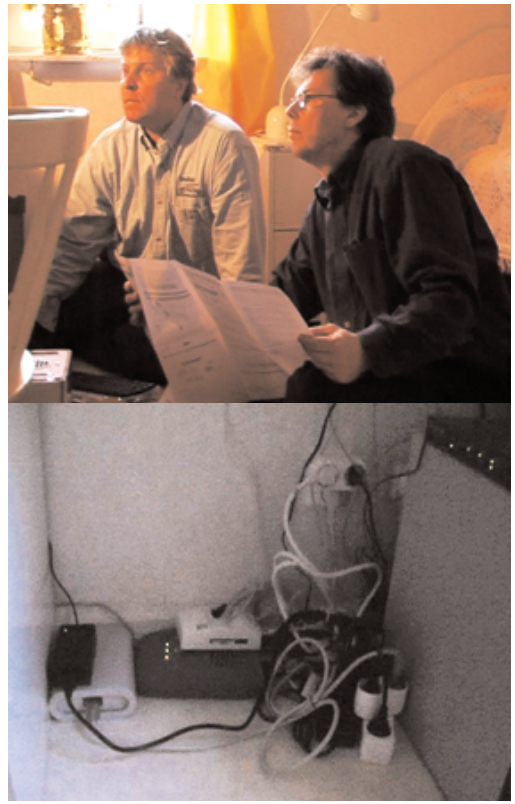
The text on the next page shows not only all the effort we had to put into installation of the technology. It also shows how much information about relations and other technology use you get every time you make a home visit. Things that you do not think of as a researcher to ask for, not at the time for technology installation anyway. Like the close relation between Monica and her sons, the touching phone call from her youngest grown up son who just wanted some nice words from his mother.

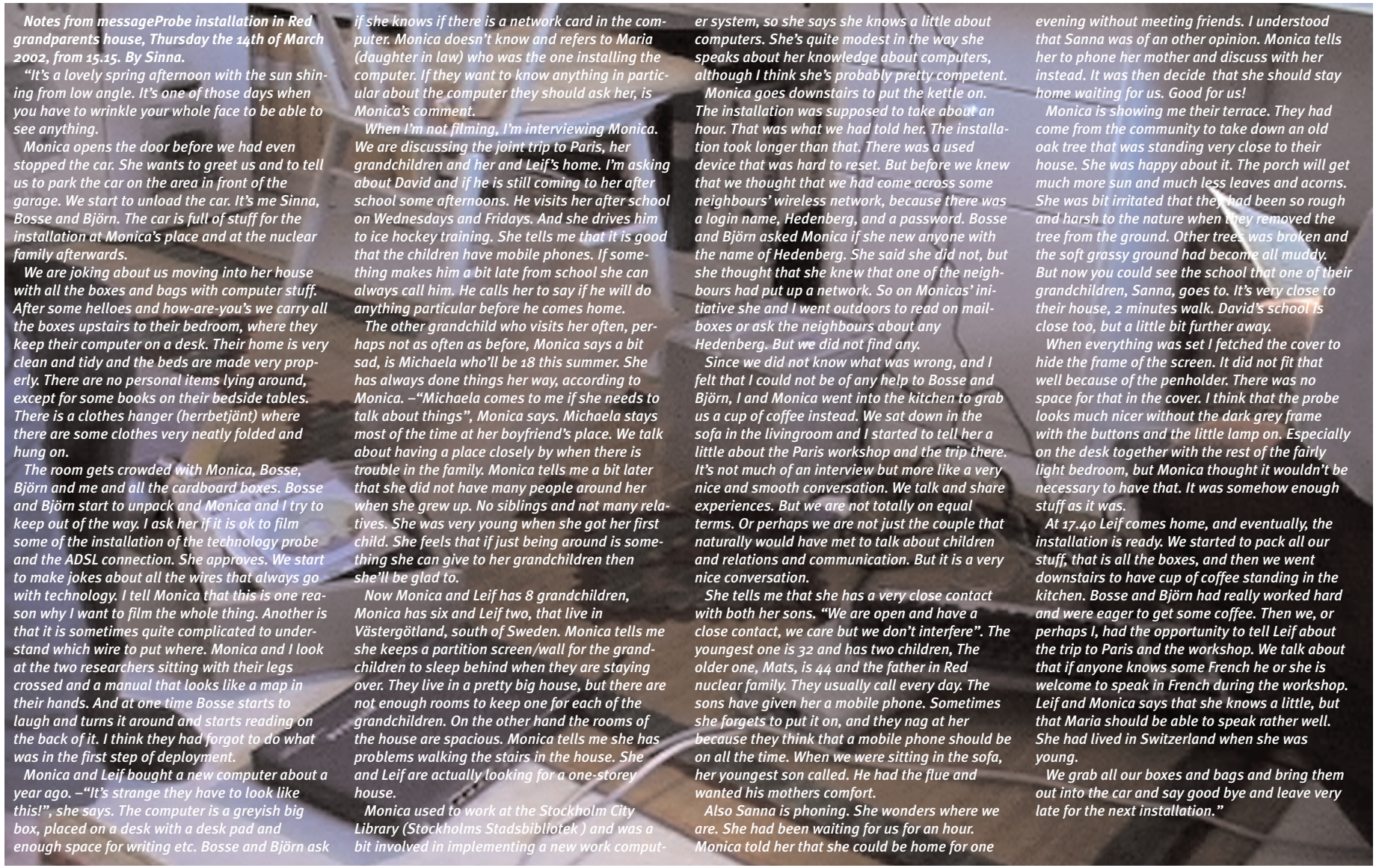
Linda Red, who lived in Örebro (2.30 hours from Stockholm) at the time for first installation, already had broadband access. The only thing we had to do was to talk to the provider, Telia ComHem, to open the line to her and for us to start paying for it. That is what we thought. Every time we phoned the company they told us different stories of how long it would take and what we and Linda had to do. Some papers were sent to Linda that had to be signed by her, weren't signed or perhaps not even received by her. Linda studied in Örebro but had her boyfriend, Henrik, in Stockholm, so she spent much time somewhere else than in her apartment in Örebro. When Linda moved to her boyfriend in the end of May 2002 we still had not got anything in order. So, we decided to put the messageProbe in Lindas and Henriks apartment instead. It was much easier, but for the payment bit we do not know yet if it works smoothly. The Internet provider has some difficulties with sending the bill to someone else, KTH, than the one on the contract.

What has this to do with the messageProbe? Nothing much really, but for the implementation it has been crucial. It took us an enormous amount of time and effort just to open the broadband connection. What we learned from that was that it would have been easier if we were in the same place at the same time with all the people concerned; Linda, the Internet provider, researchers and people dealing with practical matters like economy. That would probably have made things go easier. We then could have talked to the company, to Linda and sign papers at the same time.

Figure 1.4.1 (top)
Björn and Bosse installing a messageProbe in Barbro and Leif Red's household. Here they are trying to configure a router that did not work like it should.

Figure 1.4.2 (below)
The necessary stuff besides the actual probe.





Notes from messageProbe installation in Red grandparents house, Thursday the 14th of March 2002, from 15.15. By Sinna.

"It's a lovely spring afternoon with the sun shining from low angle. It's one of those days when you have to wrinkle your whole face to be able to see anything.

Monica opens the door before we had even stopped the car. She wants to greet us and to tell us to park the car on the area in front of the garage. We start to unload the car. It's me Sinna, Bosse and Björn. The car is full of stuff for the installation at Monica's place and at the nuclear family afterwards.

We are joking about us moving into her house with all the boxes and bags with computer stuff. After some helloes and how-are-you's we carry all the boxes upstairs to their bedroom, where they keep their computer on a desk. Their home is very clean and tidy and the beds are made very properly. There are no personal items lying around, except for some books on their bedside tables. There is a clothes hanger (herrbetjänt) where there are some clothes very neatly folded and hung on.

The room gets crowded with Monica, Bosse, Björn and me and all the cardboard boxes. Bosse and Björn start to unpack and Monica and I try to keep out of the way. I ask her if it is ok to film some of the installation of the technology probe and the ADSL connection. She approves. We start to make jokes about all the wires that always go with technology. I tell Monica that this is one reason why I want to film the whole thing. Another is that it is sometimes quite complicated to understand which wire to put where. Monica and I look at the two researchers sitting with their legs crossed and a manual that looks like a map in their hands. And at one time Bosse starts to laugh and turns it around and starts reading on the back of it. I think they had forgot to do what was in the first step of deployment.

Monica and Leif bought a new computer about a year ago. –"It's strange they have to look like this!", she says. The computer is a greyish big box, placed on a desk with a desk pad and enough space for writing etc. Bosse and Björn ask if she knows if there is a network card in the computer. Monica doesn't know and refers to Maria (daughter in law) who was the one installing the computer. If they want to know anything in particular about the computer they should ask her, is Monica's comment.

When I'm not filming, I'm interviewing Monica. We are discussing the joint trip to Paris, her grandchildren and her and Leif's home. I'm asking about David and if he is still coming to her after school some afternoons. He visits her after school on Wednesdays and Fridays. And she drives him to ice hockey training. She tells me that it is good that the children have mobile phones. If something makes him a bit late from school she can always call him. He calls her to say if he will do anything particular before he comes home.

The other grandchild who visits her often, perhaps not as often as before, Monica says a bit sad, is Michaela who'll be 18 this summer. She has always done things her way, according to Monica. –"Michaela comes to me if she needs to talk about things", Monica says. Michaela stays most of the time at her boyfriend's place. We talk about having a place closely by when there is trouble in the family. Monica tells me a bit later that she did not have many people around her when she grew up. No siblings and not many relatives. She was very young when she got her first child. She feels that if just being around is something she can give to her grandchildren then she'll be glad to.

Now Monica and Leif has 8 grandchildren, Monica has six and Leif two, that live in Västergötland, south of Sweden. Monica tells me she keeps a partition screen/wall for the grandchildren to sleep behind when they are staying over. They live in a pretty big house, but there are not enough rooms to keep one for each of the grandchildren. On the other hand the rooms of the house are spacious. Monica tells me she has problems walking the stairs in the house. She and Leif are actually looking for a one-storey house.

Monica used to work at the Stockholm City Library (Stockholms Stadsbibliotek) and was a bit involved in implementing a new work computer system, so she says she knows a little about computers. She's quite modest in the way she speaks about her knowledge about computers, although I think she's probably pretty competent.

Monica goes downstairs to put the kettle on. The installation was supposed to take about an hour. That was what we had told her. The installation took longer than that. There was a used device that was hard to reset. But before we knew that we thought that we had come across some neighbours' wireless network, because there was a login name, Hedenberg, and a password. Bosse and Björn asked Monica if she new anyone with the name of Hedenberg. She said she did not, but she thought that she knew that one of the neighbours had put up a network. So on Monicas' initiative she and I went outdoors to read on mailboxes or ask the neighbours about any Hedenberg. But we did not find any.

Since we did not know what was wrong, and I felt that I could not be of any help to Bosse and Björn, I and Monica went into the kitchen to grab us a cup of coffee instead. We sat down in the sofa in the livingroom and I started to tell her a little about the Paris workshop and the trip there. It's not much of an interview but more like a very nice and smooth conversation. We talk and share experiences. But we are not totally on equal terms. Or perhaps we are not just the couple that naturally would have met to talk about children and relations and communication. But it is a very nice conversation.

She tells me that she has a very close contact with both her sons. "We are open and have a close contact, we care but we don't interfere". The youngest one is 32 and has two children, The older one, Mats, is 44 and the father in Red nuclear family. They usually call every day. The sons have given her a mobile phone. Sometimes she forgets to put it on, and they nag at her because they think that a mobile phone should be on all the time. When we were sitting in the sofa, her youngest son called. He had the flue and wanted his mothers comfort.

Also Sanna is phoning. She wonders where we are. She had been waiting for us for an hour. Monica told her that she could be home for one evening without meeting friends. I understood that Sanna was of an other opinion. Monica tells her to phone her mother and discuss with her instead. It was then decide that she should stay home waiting for us. Good for us!

Monica is showing me their terrace. They had come from the community to take down an old oak tree that was standing very close to their house. She was happy about it. The porch will get much more sun and much less leaves and acorns. She was bit irritated that they had been so rough and harsh to the nature when they removed the tree from the ground. Other trees was broken and the soft grassy ground had become all muddy. But now you could see the school that one of their grandchildren, Sanna, goes to. It's very close to their house, 2 minutes walk. David's school is close too, but a little bit further away.

When everything was set I fetched the cover to hide the frame of the screen. It did not fit that well because of the penholder. There was no space for that in the cover. I think that the probe looks much nicer without the dark grey frame with the buttons and the little lamp on. Especially on the desk together with the rest of the fairly light bedroom, but Monica thought it wouldn't be necessary to have that. It was somehow enough stuff as it was.

At 17.40 Leif comes home, and eventually, the installation is ready. We started to pack all our stuff, that is all the boxes, and then we went downstairs to have cup of coffee standing in the kitchen. Bosse and Björn had really worked hard and were eager to get some coffee. Then we, or perhaps I, had the opportunity to tell Leif about the trip to Paris and the workshop. We talk about that if anyone knows some French he or she is welcome to speak in French during the workshop. Leif and Monica says that she knows a little, but that Maria should be able to speak rather well. She had lived in Switzerland when she was young.

We grab all our boxes and bags and bring them out into the car and say good bye and leave very late for the next installation."

USE EXPERIENCE OF THE MESSAGE PROBE

In Sweden the messageProbe was installed in all of the three Red and two of the Green family households over several months during the summer of 2002. The probes in the Red households were installed about a month earlier than the ones in the Green households. And since there was considerable technical trouble to begin with the Red households really got a bad start. Neither of the households feel trust in the application since it stops working a lot. This can be one reason that there are very few notes on the Red messageProbe. But there can be other reasons as well.

There is considerable difference between how much the Green sisters and how much their husbands/fiancés have used it. It seems that the sisters, Hanna and Sara, have used it like a natural continuationof how they always have written notes and sent each other messages. Hanna and Sara, their husbands/fiancés, Jonas and Thomas, and also their parents, Barbro and Lennart, have told us the same story of the sisters ways of communicating throughout their lives. It's a constant flow of notes, with text and drawings, answering machine messages and telephone calls. According to Jonas and Thomas, it is part of their family culture. Jonas and Thomas have not had the same "note-culture" during their upbringing, and they both have explanations to that. Jonas says once that he thinks it is because he lived more centrally compared to the sisters who lived in the countryside. He, who grew up with four brothers, also believes that parents are more protective of their daughters than of their sons.

Nowadays Hanna and Sara send SMS messages a lot to each other. Recently they also have persuaded their mother to read and write SMS messages. They say that they do not talk very much on the phone. Hanna even says she doesn't like talking on the phone. But Jonas and Thomas think they talk almost too often.

Their use of the messageProbe, is just another way of leaving notes. It fits their "note-culture". There are many notes asking "Are you there?", but after some time they stopped asking that. Hanna comments that the messageProbe doesn't work when you want to leave an urgent message or want a quick reply. But, she comments, you already have the telephone to use for that.

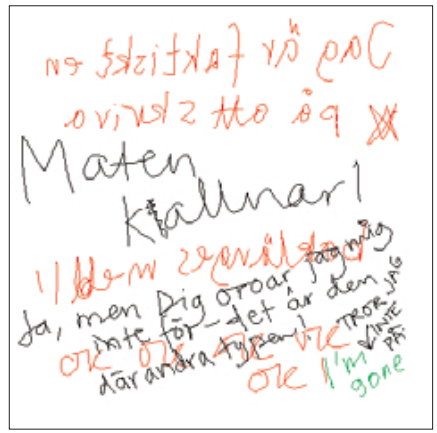
They have all thought of ways to make you aware that someone on the "other side" is making a note. They have discussed a "pling" signal or a blinking light. The negative side to that, they think, is that you perhaps just end up with yet another thing that draws your attention from whatever you do. Sara points out that she and Hanna have different evening "schedules". It's making dinner, being together with the children and then putting them to bed, taking care of the laundry etc. Usually she does not have time for the messageProbe before 10.30 in the evening. That's about bedtime for Hanna. So, a "pling" signal, when your occupied with other stuff, could be annoying.

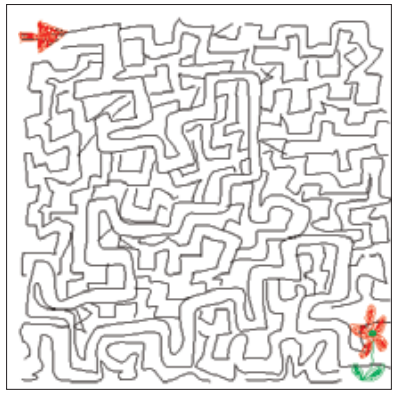
The notes on the messageProbes are very playful. For example, Hanna has drawn together with lit-

Figure 1.4.4 (top):
Besides other issues Sara started to write backwards on this note.

Figure 1.4.5 (bottom):
Here Hanna wanted to show that she also is a star (*) herself at writing backwards. In the middle of the note it says:

"The food is getting cold!" (Maten kallnar!)





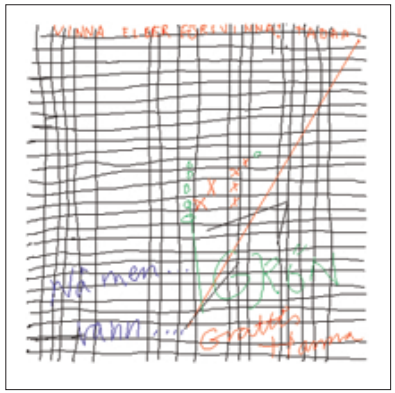


Figure 1.4.4:
Hanna: – Here is "fritt fall" free-fall" and there are you, where you have drawn the stomach. (laughter)
Sara: – ...When riding free-fall, yea...

Figure 1.4.5:
Hanna made a labyrinth for Vera (4 yo). But for some reason Vera wasnt interested in trying it.

Figure 1.4.6:
Hanna made a dotted fish for Vera to fill in (red lines + black fins and mouth.). But Vera saw something else.

Figure 1.4.7:
Big playing board made after the note in figure 3.4.1.

Figure 1.4.8:
After a visit to an island in the archipeligo Vera draws this. The parents have annotated it: båt=boat, brygga=landing, snöre = rope, ö = island. And in the lower right corner: a rope that goes down into the sea.

Figure 1.4.9:
Does Anyone Want to Draw? Noooow!!!

tle Vera. She made different drawing games for her, like dots to draw lines between to make a figure and a labyrinth. Both Vera and Arvid have really enjoyed the messageProbe. Actually, they like it so much that they always fight about the pen. That, and the fact that Arvid hid the pen once in his toy truck, made the parents hide the pen in a childproof place.

Hanna says that the printed notes we showed them were like a family diary. It would be nice to print the notes yourself, to keep them. Many of the notes follow each other like a little story. But one note can also be a whole story, like the map over Sara's home on where the messageProbe screen was placed, or the drawing of a man in a suit. These notes were annotated from "both sides" many times. And when there was no more space to write on they continued on another note.

You can tell that these persons connected to the messageProbe know each other well. They follow each others thoughts easily and know exactly what to joke about and how. Misinterpretations are not necessarily bad. They could be the foundation of another drawing joke. They all think that it would be different to have someone else connected to it. Perhaps a bit more problematic but they were eager to try that with the grandparents Barbro and Lennart.

In spite of all the problems with it; the breakdowns, the slow zooming etc, they all enjoyed it. They really had a good time playing with it and said they would miss it if we took it away. So we left it there for the time being.

DATA COLLECTION

We wanted to be sure to get as much out of the use of the probes as possible and decided to have notebooks beside them so that it would be easy to write down impressions. We spent some time looking for small, good-looking notebooks in the "family colours" to give to the adults. As with the Communication Probes in the beginning of the project we find it important that all the things we give the families have a character that shows the spirit of the project. We hope that this inspires the families to put more effort into their part of the work.

Contrary to the adults, Vera Green, 4 years old, got a rather big colourful notebook with a green-glittery pen to use for writing and drawing. We hoped that this would make her interested in giving her comments.

We did not get one single comment in the books, but they might have helped in showing the families that their feedback was important. But since we had all the notes available it seemed rather easy for them to remember specific events.

THE IMPRESSION WHEN USING THE MESSAGE PROBE.

Since the idea was that the probe should feel different from a computer we tried to take away many of the common visual computer signs, like title bars, borders, bad typography, symbols to click on, etc. We also chose a computer without a fan, the Apple Macintosh Cube.

We tried not to signify computer, not to evoke meanings of "normal" computing. And we also held simplicity high. One example is that we chose not to zoom in and out with two different "symbols / buttons", like controlling a machine. Instead the user simply gets the available possibilities when moving the cursor around the screen. The blank note interface invites to use the colour tools to write and draw on it.

It is difficult to say exactly what the resulting effect was. The few people that really liked using the messageProbe did not seem to have given the appearance much thought. Thomas, who works all day in a computer related area, expressed that he thought that the messageProbe looked like a Beta-release due to the lack of technological details, like sound alert, date and time stamps, sender, etc. But after using it for some time he starts to change his mind and says:

– I start to think it is brilliant. It's so simple but you get so much anyway.

Jonas comments that he is so used to the Microsoft appearance that you more or less expect that of all things you see on a screen.

Unfortunately we could not remove or hide enough. The behaviour is still "computerish": it makes too much noice, the screen lights up the room, it crashes, awkward flipping through notes, etc.

People tend to regard the probe both as a whole and in relation to the meaning it had to them, if they could fulfil their intentions or not. This is, not surprisingly, fully in line with the current discussions in product semantics. (Krippendorff, 1995)

Figure 1.4.10 (top):
The print-outs of all the notes added a new dimention since it was a lot easier to look at and also get an overview:
"Almost like a diary".

Figure 1.4.11 (bottom):
Hanna: " You're so used to, when looking at a computer screen, it should look so "professional", and when you see all our scribble all over the screen, it looks so….that's my interpretation…"

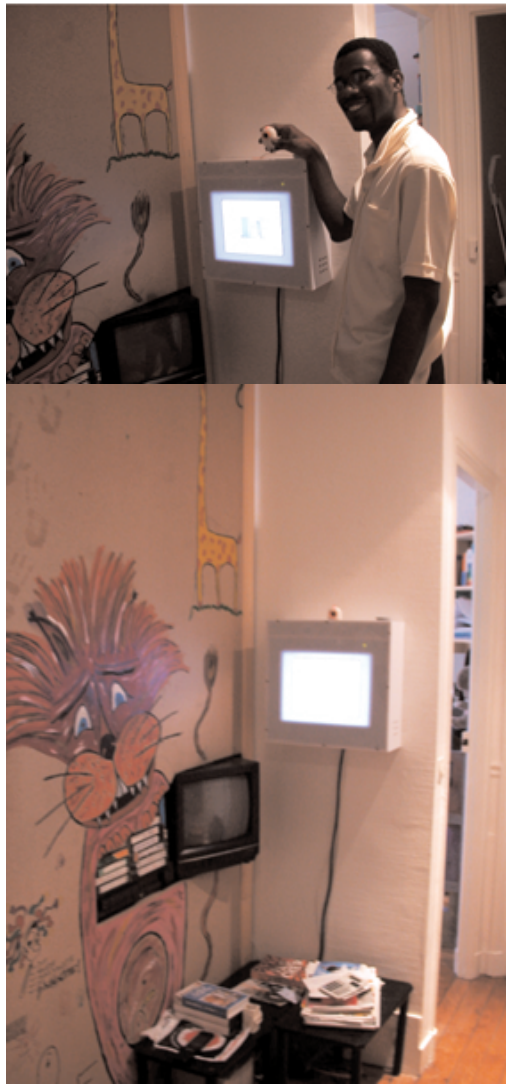


Figure1.4.12: videoProbe as part of a 'media centre' in the corridor

Family use experience of the videoProbe in France

We knew that actually introducing a new, networked technology into the families' homes would be time-consuming and difficult. But we had no idea just how complex the operation would be and the wide variety of problems, not all technical, that would arise.

We began the process by interviewing the families to find out what their current network connections were. None had the requisite connections (usually an ADSL line), and two did not even have a phone line (they used their mobile phone). So we had to negotiate with the University to pay for such lines in homes (a multi-month process) and also had to negotiate repeatedly with France Telecom (easily a six-month effort, since we started working on this in January, 2002). The main problem with France Telecom was that they would assure us that the line had been installed and was working when it was in fact, either not installed or not connected.

After the joint French-Swedish workshop held in Paris in the beginning of May, we chose the family members who wanted to be the first to try to videoProbes. The Orange family and the Purple family each offered preferred and secondary households that they'd like to connect to. We selected two nieces in Paris (mostly for proximity reasons) who wanted to be connected to the main Purple household, and two brothers in the Orange family.

(Read more about the videoProbe in 2.3 VideoProbe)

Since most visits take approximately half a day for travel to and from the site, we tried to work over the phone and only arrive when we were sure that everything was ready for the installation. Even so, in more than half the cases, we would arrive to find a major problem with the network. Thus far, we have installed four videoProbes in the homes of the French families.

We began with the Violet family, with the core household approximately 90 minutes to the north of Paris and two sisters who live in the centre of Paris. When we arrived to install it with the first niece, the line was not working, after which she left on vacation. So the videoProbe is in place, but not actually connected to network. We arrived at the second niece's apartment and again had problems with the line. So we returned and were successfully able to install the videoProbe and connect it to the network. She and her roommates were happy for us to drill a hole, so we could place it on the wall. They also moved things around and were interested in finding a location that coincided with their daily routines and was integrated into their living space. One of the nieces had already designed a kind of 'media wall' in the corridor of her flat, due to the lack of space in the apartment. The corridor was designed as a substitute for a social lounge area and the videoProbe fit very well into this environment (figure 1.4.12). Unfortunately, before we were able to connect her probe to her sister's probe, she called to say that her landlord was forcing her to move. So, she is currently in transition and we are

waiting until she reaches her new apartment to try to reconnect the two sisters.

The second pair of videoProbes were installed in the homes of two brothers from the orange family, both living in suburbs of Paris (north and west). As before, we arrived to find that there were problems with the line. We worked with France Telecom and returned to install a videoProbe in the core orange family's home and the father's brother. Both of these families decided that they wanted to place the videoProbes in the main living area, where it could be seen from both the sofa and the dining room table. Unlike the sisters, the setting was more formal and it was not possible to hang the probes on the wall. Fortunately, they were designed to be placed on a table or sideboard (figures 1.4.13 and 1.4.14). In each of these cases. The family members rearranged the surface to accommodate plants, vases and lamps.

The first of this pair worked for a short time and then stopped. We traced the problem to an alarm system that detects the connection and shuts it off! We have not yet resolved how to fix this, without interfering with the alarm. The second of this pair of videoProbes worked fine for a while and then suddenly stopped working. We discovered that someone had managed to press the "on/off" switch, behind the white plastic cover that protected the LCD screen. We had to return to the house and remove the casing in order to turn the display back on.

figure 1.4.13 (top two): videoProbe on a sideboard in the living room: first family

figure 1-4-14 (bottom two): videoProbe on a sideboard in the living room: second family

1.5 Prototyping with families

Fig 1.5.1:
The Blue family have always expressed their "note problem". Here at one of the many home visits they continue to tell us stories.

The future use of the eventual artefacts are in focus during most of the work but we have also done some rewarding work directly with prototypes in some of the families. Below is a description of some work with the Blue nuclear family. There are more angles to this work and also work together with other families in chapter 3 Prototypes.

Prototyping with the Blue family

The Blue nuclear grown ups have been very clear with their problem regarding the administration of notes, letters from school, sport activities, home-work, etc.from the very beginning of the interLiving project. This has been shown and described by the family in most of the 2nd Swedish workshop, the May 4th joint workshop, through probes and several home visits. At first the researchers rejected the "calendar" idea for not being novel enough. But after a DC workshop with the Mime and Accord projects we realized that it was possible to develop something really new and useful. One of the triggers was a comment by Eva Blue regarding a test they were doing themselves. She had printed an Outlook calendar and taped it on the fridge door. Every morning before leaving the house she went there and looked at what was on that specific day.

The idea that was developed at the DC workshop was a "door" that displayed today's events to the person leaving the house. The door was augmented further with recording and networking possibilities.

(For more information see 4.1 about the DC workshops and 3.2 about the door prototype)

DOOR PROTOTYPE

In order to get more relevant data of what events, messages, etc. that were relevant to the family we placed a simple low-tech prototype on and near their front door. It consisted of an A3 paper pad, five differently coloured pens, a Polaroid camera and a MiniDisc recorder. Each family member had his/her own coloured pen to write with.

The family used this for two weeks. After that we made a visit and discussed the results. They made notes of everything noteable, when they remembered to do it. The kids surprised the parents by writing "We are down on the field" the first day. The parents did not even think of looking at the door until after a while.

Roughly we sorted the different messages into the following categories: today (18), temporary (later message or delete overrules) (10), some later day (8), until it is done (6) and comments to other notes (3). The sound recording was a problem since there was no visual clue showing whether there was any new message or not. They expressed how convinient it would be if you could speak and listen to notes.

SECOND POST-IT PROTOTYPE

Inspired by how fun the Green family's messageProbe use was we wanted to see how a more writing/drawing based "door prototype" would work. We decided to try with Post-It notes instead of new sheets of paper to write on. This way the "until it is done" messages would not have to be re-written as in the previous one where we used a new paper for each day.

Basically we just gave the family a couple of pads with differently coloured Post-It notes and a disposable camera in order to take daily photos of the notes. Our idea was that the notes should go on the door, but the family members were afraid that they would fall off due to the wind and slaming. They decided to use a frame with glass in the hall rather close to the front door. The illustration in the frame contained parts of a logbook from a ship, which was an interesting coincidence.

After two more weeks we returned to the Blue's home to have a look at and discuss what had happened. Since this surface did not change every day, they had developed a layout that had all the recurring events on the left hand side ordered by the day of the week. On the right hand side they had on-time events with the closest one at the bottom. As if they were falling off. In the middle were a couple of notes like "Math homework", perhaps the start of a "to do" area.

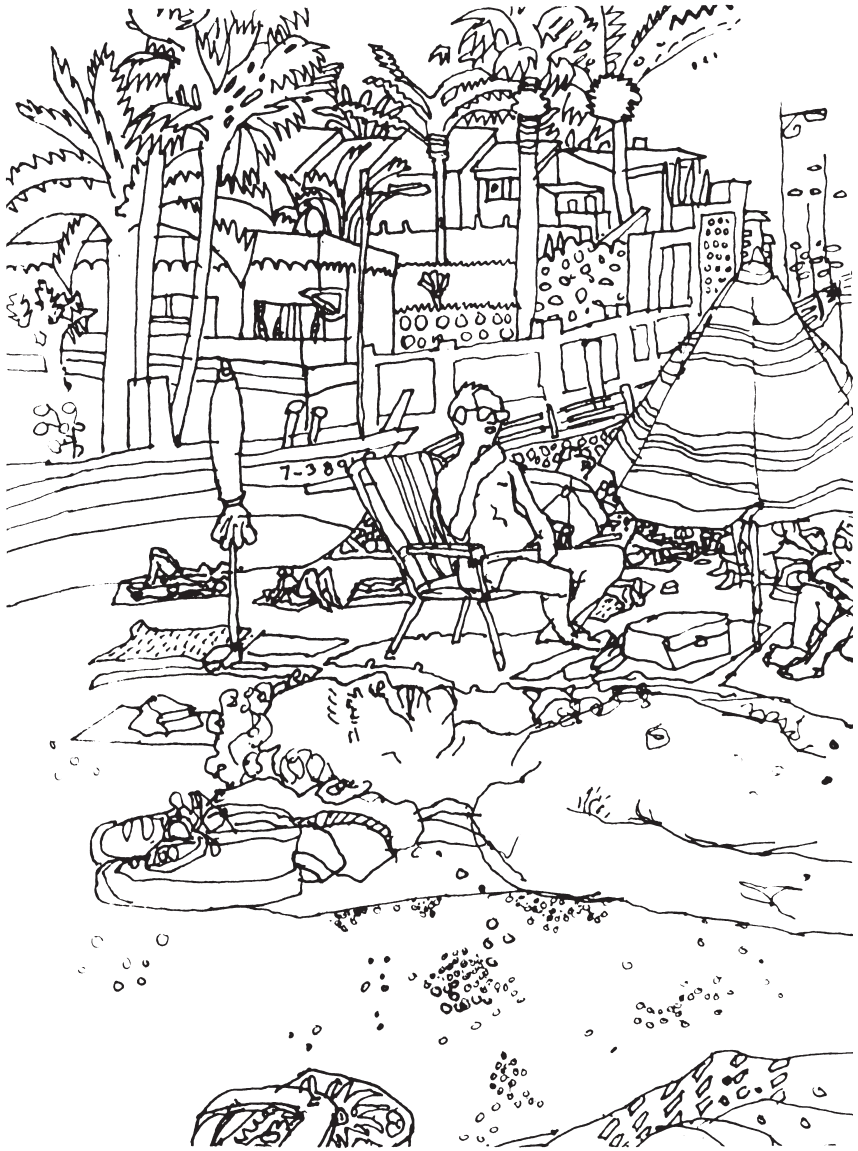
CONCLUSION

Prototyping together with the family is working very well. All the members of the family put lots of effort both in "using" the prototypes and in the discussions of development and future work. It also seems to have been a good idea to leave the prototyping exercises so open ended as they were. That way we did not only get answers to our questions but a lot of additional knowledge about the families natural way of functioning.

It is easy for them to make up and tell short, specific future scenarios related to the prototypes and relevant to their own life. We are all really exited about what will happen when we install the first computerized and networked prototype.

Fig 1.5.2 (top):
On the first low-tech prototype a Polaroid camera that "played" the role of a scanner.

Fig 1.5.3 (bottom):
"The natural place to collect and hopefully find stuff." This is just inside the front door.


7-389

2 Technology Probes

2.1 Concept

One of the key objectives of the InterLiving project is to experiment with different design methodologies. Each of the three organizations represented have long-standing experience in participatory design, which remains the core strategy for the project. However, we each have different experiences and perspectives. The Swedish group's work helped found the field of cooperative design, and has its roots in labour relations. Their "Scandinavian approach" has fundamentally influenced CSCW and participatory design research world-wide. The American group has concentrated on participatory design with children, developing the idea that children can be true design partners. The French group has focussed on adults in work settings, developing technology that emerges from existing work practices rather than replacing it and developing methods for helping people with different disciplinary backgrounds to communicate effectively. Families, and the individuals within them, represent a new user group for all of us. InterLiving provides us with the opportunity to examine our differences, draw from our collective backgrounds and integrate the most effective approaches.

The interLiving partners use design methods from the social sciences, engineering and design. One of our key challenges has been to develop strategies in which family members can actively participate in the design process, including the design of new technology. We would like to develop better ways of letting the family members directly influence and shape the design of communication technologies we develop for them. The standard HCI approach would be to interview the families, create a design, develop the technology and then test it to see what the families like or do not like. However, we would like to come up with methods that allow the families to more directly inspire and shape the communication technologies that we develop and they use. Note that we do not expect the family members to become designers; but we do want them to be active partners in the design process. We have successfully used the workshops, with a multi-disciplinary set of design exercises, to work with families as they generate specific design ideas, placed in the context of real-world events and activities. However, we are still seeking additional methods to co-design together.

We have found that working directly with technology is difficult. Although we can use the HCI strategy described above, we believe that it discourages active participation by users. In such situations, the basic technological design concept is already well established by the time the users see it, so their suggestions usually relate to details about the user interface and are rarely fundamental

contributions to the overall design. So our challenge is to create a strategy for allowing family members to make fundamental as well as incremental contributions to the design.

Our original proposal was to distribute "seeding" technologies into the families' homes, to provide them with ideas about what we would like to develop. We expected them to critique these seed technologies and provide us with feedback that would affect our subsequent designs. As the project progressed, we shifted to the concept of a 'technology probe', which combines the social science goal of collecting data about the use of the technology in a real-world setting, the engineering goal of field testing the technology and the design goal of inspiring users (and designers) to think of new kinds of technology. For us, technology probes are tools that both help us study how and why family members communicate and at the same time, motivate them to think about new kinds of communication technologies.

We believe that a well-designed technology probe should balance these different disciplinary influences. On the social science side, technology probes explicitly reject the strategy of introducing technology that only gathers 'unbiased' data, in the ethnographic sense of an unobtrusive "fly on the wall". We assume that these probes will change the behaviour of family members and the character of their interfamily communications. On the other hand, we recognize the benefits of collecting data in situ and we are interested in observing how their communication patterns and their interpretation of the technology changes over time. Because we instrument our technology probes, we can capture both types of data: the use of the probe itself and the relationships within the family. Successful technology probes should be explicitly co-adaptive (Mackay, 1990): we expect the families to adapt to the new technology but also adapt it in creative new ways, for their own purposes. Ideally, technology probes will spark new ideas and help the families articulate ideas for the prototypes we will build.

On the engineering side, technology probes must work in their intended real-world setting. They are not demonstrations, in which minor details can be finessed or glossed over. They must really work and be usable over periods of weeks or even months in the families homes. So all the main technological problems must be solved for the technology probes to serve their purpose. If we were creating a prototype of a complex system, this would take a great deal of time and make it very difficult to then throw the probe away. The theory behind the probes is that they are based on simple technology, with limited functionality, and can thus be created and subsequently discarded relatively easily.

On the design side, technology probes are influenced by cultural probes, as introduced by Gaver and Dunne (1999) in that they are meant to inspire users to reflect on their everyday activities in different ways. (Note that we have used variations of two early types of cultural probes, when we provided family members with disposable cameras and asked them to generate maps representing their family relationships.) However, we distinguish

between cultural probes and technical probes, in that the former are extremely lightweight, need not involve any technology at all, and concern a single directed activity executed at a particular point in time. The emphasis on cultural probes is that users are given the opportunity to express themselves creatively through photos, drawings, voice records and other more unusual objects. However, they are not meant as a tool for users to participate in the design process. Dunne and Raby's Placebo Project (2001) is perhaps closer to our concept of a technology probe, in that they introduce thought-provoking technologies into people's homes for periods of time. However, they do not explicitly use the technology to collect data about its own use, nor do they ask users to participate in the subsequent development of new design ideas. Our version of technology probes involves installing a working technology into the families' homes and watching them use it over a period of time. Users are asked to use the technology probe in the course of their daily lives, in our case for family communication, and then reflect upon that use.

The goals of a technology probe include:

- inspiring users and designers to generate new design ideas
- understanding how a technology is used in a real world setting
- studying emergent patterns of behaviour around new technologies
- creating a common ground for subsequent design collaborations

A well-designed technology probe should be technically very simple and very flexible with respect to possible use: it is not a prototype or early version of a technology we are seeking to develop, but rather, an indication of technologies that would be interesting to pursue. Technology probes may be based on new or existing technologies, but must be open-ended and act as catalysts for new ideas and activities by the family members. Unlike prototypes, technology probes are not meant to be iteratively redesigned though a user-testing cycle. Instead, they are meant to be introduced once, for a period of time, and then discarded. Technology probes can be distinguished from prototypes (and products) as follows:

- *Functionality*: Technology probes should be as simple as possible, usually with a single main function and two or three easily-accessible functions. Prototypes may have many layers of functionality and address a range of needs and uses.
- *Usability*: Technology probes are not primarily about usability in the HCI sense, so during the use period, we do not change functions (except to fix bugs). For prototypes, usability is a primary concern and the design is expected to change during the use period to accommodate input from users.
- *Logging*: Technology probes collect data about relationships within the family and help family members (and us) generate ideas for new technology. We should provide ways of visualizing the use of the probes which can be discussed by both users and designers. Prototypes can collect data as well, but this is not a primary goal.

- *Flexibility*: Although technology probes should not offer many functionality choices, they should be designed to be open-ended with respect to use, and users should be encouraged to reinterpret them and use them in unexpected ways. Prototypes are generally more focussed as to purpose and expected manner of use.
- *Originality*: Technology probes can be very unusual, but need not be. Prototypes should provide new functionality that meets needs specified in the design requirements for the project.
- *Design cycle*: Technology probes are intended to be introduced relatively early in the design process as a tool for challenging pre-existing ideas and influencing future design. Prototypes appear later in the design process and are intended to be improved iteratively, rather than thrown away.
- *Longevity*: Technology probes are intended to be thrown away; only the ideas and experiences are fed into the later design process, not the code or design itself. Prototypes are meant to serve as the foundation for the final developed version of the product; they are usually incrementally improved until the desired level of robustness and usability is achieved. (Note that the code in some prototypes is also thrown out before product development, but the design of the prototype serves as a blueprint for the design of the product.)
- *Concept*: Technology probes are a method that we are experimenting with, and the full definition is still under construction. Prototypes are well-defined concept in software engineering and in HCI (see Beaudouin-Lafon & Mackay, 2001 for a detailed discussion of prototyping methods).

The visual appearance of the probes is important: The look and feel must be simple, natural, fit within the home surroundings and not appear to be a computer. We removed the timestamp from the messageProbe for this reason: it looked too much like a computer file. We also avoid borders and contour lines, since these are common signs that signify "computer" but rarely appear in the physical world. We have also built casings around the technology, to make them seem less like standard computers and to disguise the much-reviled heap of cables. Once placed in the home, technology probes should encourage family members to experiment with it in ways we haven't considered and reflect aspects of how the family members interact with one another. Designers and family members can then use the experience of using these probes as a starting place for working together on new design ideas, with ideas inspired by the technology probes (in conjunction with ideas generated via other sources, such as workshops).

Use in the interLiving project

We have discussed a wide variety of possible technology probes for the interLiving project. Such probes can be used by indivduals, groups of family members or everyone in the family. They may be explicitly designed for the home settings or settings outside the home. They may be fixed or mobile,

hard-wired or wireless, large or small, new or existing.

This far, we have developed and installed two technology probes: the messageProbe and the videoProbe, described in the next two sections. Each is designed to both gather data about a family's communication patterns while inspiring them (and us) to think about new ways of communicating. These technology probes are designed for use across multiple households, in home settings and can be used by any member of the family. We have installed logging software and have discussed the use of the probes with family members in the form of interviews and the log files. Our experiences with these two technology probes, both negative and positive, have greatly influenced the design of the upcoming prototypes. In particular, we have moved away from the idea of creating a single prototype that supports a particular type of communication within distributed families. Instead, we have identified two related needs:

First, families need a far better method of specifying who they communicate with, regardless of the details of the interface and medium of communication. To meet this need, we are developing the FamilyNet, an infrastructure for a small-scale, closed, easily-configurable network with a tangible interface, that will allow families to control who they communicate with via these new technologies.

Second, families have identified a variety of different interests, from practical to whimsical. So we are developing prototypes that reflect this diversity, each designed to be built on top of the FamilyNet to allow us to demonstrate and iteratively develop the concept. On the practical side, many of the family members, particularly the mothers, expressed a clear need for a system of managing family events. The calendar, InkPad and Door prototypes, described below, are influenced by the message board probe and work done at a DC workshop. They are both attempts to provide families with flexible ways of sharing information about their activities. On the more whimsical side, many individuals expressed interest in communicating with other specific family members, sometimes one-on-one, sometimes in small groups. The The MirrorSpace, influenced by the videoProbe, will provide families with a way of seeing specific people in other households, but not necessarily everyone. The InkPad will adress peoples more whimsical aspects as well.

2.2 messageProbe

Read about the work with families and probes in 1.4.

Figure 2.2.2:
messageProbe use in the US. The keyboard is not part of the setup.

The messageProbe is a simple application that enables members of a distributed family to communicate with one another both synchronously and asynchronously with digital notes using a pen and tablet interface. Each household running this Java-based software can view, create, and manipulate notes in a zoomable space.

The design builds on work from three fields. First, the technology is influenced by synchronous shared whiteboard projects in CSCW and asynchronous commercial communication software such as instant messaging. Second, in an effort to keep remote family members connected, we were also influenced by research in remote awareness. Finally, our interface design is based on past experience with zoomable user interfaces. For more details about the design and related work, please see [Browne et al., 2001] and Deliverable 2.1. Below is a description of the most interesting design issues and decisions that were made to create the probe.

We decided to build a message probe based around virtual notes because of the popularity of paper sticky notes for informal family communications. We understood that we would lose the feature of being able to stick notes on anything anywhere in the house, but would gain an unlimited supply of notes and the ability to share them remotely with other family members.

With the potential for multiple remote family members to be viewing, manipulating, and writing on their devices simultaneously, there were a number of usability and synchronization issues to consider. Not only do family members at multiple locations share the message space, but also multiple family members at the same location share a single message creation and viewing device.

Thus, we chose to implement a bulletin board-like interface. All users share control of the notes in the message space. Anyone can write on or move a note in the space, regardless of who created it. New notes are immediately sent to all the devices in the family and are displayed in the same location on all devices. We did not want to force an organization of notes on users, but needed some way of arranging them initially. Thus, new notes are arranged according to their creation time in a grid.

Organization and personalization of notes beyond the default placement is entirely up to users. Notes can be dragged out of the message grid anywhere in the message space. Notes can also be dragged back into the grid, where they resume their place in the time-based order. As notes are added or removed from the grid, the grid reorganizes itself to fill up empty space.

This design also allows for some interesting interactions, which add to users' sense of remote awareness. Two users can draw on the same note at

the same time or one user could move a note that someone is in the middle of writing. There is also no erase or delete functionality – users simply add to existing notes, create new ones, and move old ones.

Design partners: the U.S: family

INTRODUCTION

The U.S. family we work with consists of a nuclear family (mother, father, son – age 8, daughter – age 11) and two sets of grandparents, all living within about 5 miles of each other in suburban Maryland. We met with the family to describe the project in late September of 2001. After obtaining their consent to participate, we had them create a family "communication map" with paper and markers to illustrate with who and how they communicate.

Next, we described the message probe as a new way to communicate. We left them with paper sticky notes to write on whenever they thought of a message they might want to send to each other using the message probe. The goal of this exercise was to think about family communication and how it might be accomplished through a new medium.

We met again a month later to collect and discuss the sticky notes and show them the message probe. The family members varied widely in their use of the sticky notes. One grandfather wrote more than 50 notes. The other set of grandparents wrote 8 notes together, while the nuclear family wrote 13. Interestingly, nearly all the notes were written – no drawings.

The notes fell into 5 general categories: status updates (e.g. locations and health), minor news not worthy of a phone call (e.g. went to church this morning), feelings (e.g. cheer up your day), questions and reminders (e.g. call about furnace), and coordination (e.g. what time should we come for dinner?). For both sets of grandparents, news not deserving a call was the dominant category, while coordination was most important in the nuclear family. Based in these results, we were interested to see if and how they would differ in the real messageProbe.

Probe Deployment

We deployed the probe in the three households of our US design partners for a little over a month in February and March of 2002. Following the deployment, we interviewed them in their homes. We provided computers and high-speed Internet access via cable modem to both sets of grandparents; the nuclear family already had both. We also provided them with notebooks to write down comments.

While we wanted to provide all of the households with a writable LCD tablet, we were only able to afford one of these devices. One set of grandparents used this device, while the other households used monitors and pen tablets. While we wanted to encourage the families to put their computers in a location that everyone would use and to leave it

Figure 2.2.1:
messageProbe use in the US.

running all the time, we had to be flexible to accommodate their concerns about space and aesthetics.

In the nuclear family, the computer is in the kitchen. It was used for many tasks, so the messageProbe was not always running. One set of grandparents already had a computer in an office. We put another computer, tablet, and monitor in their living room, and they left the message probe running all the time. The other set of grandparents did not have a computer but agreed to put a computer and LCD tablet in their basement. Like the nuclear family, they wanted to use the computer for other things, so they did not always have the message probe running.

The deployment actually lasted 6 weeks due to problems with one of the modems. At the end of this period, we interviewed all three households in their homes. We also logged usage statistics and captured daily screen shots.

Figure 2.2.3:
Workshop about messageProbe use in the US.

Initial Results

NOTE CONTENT

The family created over 120 notes, but we considered only 82 of these notes since some were blank and some were practice notes written with the researchers present. In all of the households, someone checked the message probe at least once a day. Like the paper notes, the messages were almost exclusively text. The exceptions were 3 tic-tac-toe boards and a smiley face. The two grandfathers wrote the most notes, followed by the father in the nuclear family. The two children wrote a few notes each and the grandmothers and the mother only wrote one or two each. The two sets of grandparents did not communicate with each other at all; they each just wrote notes to the nuclear family.

We used the same 5 categories as the paper notes to classify the messages since they seemed to fit well. Status updates were the most numerous, but many of these had to do with technology problems. Minor news, feelings, and coordination were nearly as numerous, while there were only a few questions and reminders. The major differences between the paper and electronic messages were more status updates involving technology with the message probe, and more feelings expressed with the message probe. Taking into consideration the prolific numbers of minor news notes written by one set of grandparents and technology problem notes written by the other, feelings and coordination were very popular with the message probe.

NUCLEAR FAMILY USAGE

The nuclear family is a busy household. Both parents work and the kids are involved in many activities. The parents rely on the grandparents to pick up the kids from school, so they talk on the phone to both sets of grandparents every day. The only one who used the message probe regularly was the father, who also had to field tech support calls from his dad and angry calls from his father-in-law when his modem wasn't working. The mother thought many of these calls were a waste of time and got her father upset.

The children indicated that they were frequently too busy to use the message probe, and the mother preferred to use the phone. Their computer was rather slow, and the pen tablet was awkward to use. Other than more calls from the maternal grandparents, the message probe did not really affect their communication patterns. The main effect seemed to be that they were happy that the paternal grandparents were learning to use a computer.

PATERNAL GRANDPARENT USAGE

The paternal grandparents had no prior computer experience and were unsure about participating in the project. However, after a month with the computer, they were both hooked. They wanted to use it for more than just the message probe, so this put a lot of pressure on their son to help them learn how to use it. But, this curiosity to do things like check their stocks on the Internet and play solitaire kept them interested.

Both remarked that the LCD screen flat on the table was easier to look at than the regular monitor at their son's house, especially with bifocals. However, it was slippery to write on. The lack of a delete or erase button made the grandfather self-conscious about making mistakes, so he used the notebook to write out many of his notes on paper before he wrote them on the message probe. They were a little disappointed that the grandkids did not use it more. They noted that it was fun for writing unimportant things, but used the phone if they needed a quick response.

MATERNAL GRANDPARENT USAGE

The maternal grandparents had the most trouble with the message probe. They required a new modem and a visit from the cable company to give them a new IP address, and had a problem with their pen tablet only working at night, likely due to electrical interference. Their notebook was filled exclusively with updates written by the grandfather about these problems. As a result, they had a relatively negative experience with the message probe, but remained positive about the project and our research.

They generally talk everyday on the phone with their son, often to arrange pickups from school. The message probe was not reliable enough to conduct this sort of time-sensitive coordination. So, it was more useful for fun, for being together at a distance, but less for urgent matters. Like the paternal grandparents, they were a little bit disappointed that the grandkids did not use it more.

SUGGESTIONS AND CONCLUSIONS

The family had many minor suggestions about ways to improve the message probe. Delete and erase functions were unanimously requested. The grandparents in particular were self-conscious about not being able to erase mistakes. Both sets of grandparents suggested being able to type messages with a keyboard since the pen was hard to use for everyone. The maternal grandparents also wanted a new message notification function. One of the children wanted to be able to record messages and attach them to notes. However, as a technology probe, the real goal of the messageProbe is to elicit more general ideas, which we expect to elicit in our future design sessions.

The combination of technology problems and not having the message probe visible all the time prevented the family from developing an adequate level of trust to send time-dependent messages. While we wanted the message probe to function as a standalone appliance that was always accessible, this was not realistic for the nuclear family and might have been less useful to the paternal grandparents, who used the message probe more because they were also able to use the computer to do other things.

Both sets of grandparents were disappointed that the grandkids did not use it more often, indicating that a technology providing more contact with the grandchildren would be useful. The main change in communication was that both grandfathers called the father more frequently because they had computer questions. The women seemed to strongly prefer talking on the phone to writing notes. Many of the communications via phone and message probe involved coordination for childcare, indicating that this may be a promising area for new technologies.

Figure 2.3.1a: videoProbe display and camera.

2.3 videoProbe

The videoProbe was originally conceived of as a lightweight technology probe, to be introduced in the family's homes during the calendar year 2002. The basic design has not changed since the prototype we demonstrated at the Disappearing Computer jamboree in October, 2001 and described in deliverable 1.2, although the software has been completely rewritten and we have designed completely new packaging for the hardware.

The following sections describe the redesign of the video probe, including the technology and packaging, and outlines our experiences installing them in the families' homes. We then discuss how this has inspired future work, with an explicit follow-on prototype, called MirrorSpace, and the design requirements for a new type of family-friendly network, which we call FamilyNet, which would make these and a wide variety of other technologies actually work in real-world settings.

Description

The design brief was to create a simple method of sharing impromptu images among family members living in different households. We use a video camera that detects when a moving image has remained steady for approximately three seconds. The resulting images are collected, stored and made available to anyone else in the network. Images fade over time, but family members can use a small hand-held device to save desired images in an album. As a technology probe, our goal was to both create an extremely simple, but also very open-ended system that would inspire and encourage new types of communication among family members (in the sense of a cultural probe) while providing an unobtrusive source of data to us about how these households communicate with each other.

Hardware

The primary concern in choosing the VideoProbe hardware was to create a system that did not look like a computer, which would "disappear" and not look like we'd added new technology to the family's homes. We wanted something that was silent and something that was attractive. The VideoProbe consists of:

- Apple Cube
- Wacom PL-500 LCD screen and touch tablet
- Philips ToUCam Pro USB camera
- Apple USB speakers
- USB hub
- Keyspan Digital Media remote control

Software

The first prototype version of the videoProbe was designed to explore the idea and allow us to test it with families in the context of the first French family workshop. The software was implemented in C, using videoSpace (Roussel, 2001) and acted as a stand-alone system. We gave a brief demonstration of the VideoProbe and let it run throughout the workshop. Many of the participants, particularly the children, played with it and we listened to their comments.

We knew that we had to rewrite the software from scratch, to create a reliable system that would work across several households, using the hardware we had chosen. The basic software could be rewritten quite quickly (in C++ on Unix). We modified the overall architecture and network, added data logging, and modified the appearance and user interaction, as follows:

Architecture: We use a client-server architecture, in which all images are collected and sent to a central server. We and the families have access to this server, and this arrangement also allows us to remotely restart the system, if necessary. Since most DSL ISPs assign dynamic IP numbers, we had to register each of the Cubes with a Dynamic DNS service (www.dyndns.org).

We also needed to introduce a more sophisticated calibration system, to handle changes in lighting conditions and camera orientation. When initialised, the system takes a reference shot. Then, it can detect movement by checking for differences between successive images. If the system is placed near a window, the lighting changes gradually over time, which requires periodically taking new reference shots. Otherwise, it would capture images of an empty room, with slightly different lighting. Similarly, when the camera is moved, the reference frame must be updated otherwise the system would keep taking pictures. Reference shots are updated as follows: the system stores the last shot taken. When taking a new shot, it compares it with the most recent one. If they are similar, the new shot is ignored (i.e. it is not sent to the server) and the system notes this fact. If yet another shot is taken that is similar to the stored one, this shot is ignored and becomes the new reference shot. After testing the system for extended periods of time, this approach seems to give good results, with no false positives (i.e. ignoring a shot that should be kept) and very few false negatives (i.e. repeatedly taking "empty" shots).

Logging: In addition to collecting basic data, i.e. the collection of images saved by family members, we also added a logging system. This records when images are taken and when the family members use any explicit functionality, such as saving an image in the photo album.

Appearance and User Interaction: We calibrated the speed and the amount of time to wait before the system takes a new picture. (If an adult wants to pose for a self-portrait, the three-second delay is not a problem. However, we found that children find it very difficult to remain motionless for three full seconds.) We also incorporated a more sophisticated form of fading the images out by fading them

first to black-and-white and then to all white). We also changed the mapping of buttons on the remote-control to make it easier and more intuitive to manipulate (see also the repackaging of the remote control below).

One of the biggest problems we faced in the redesign was shifting to a new operating system. Using an Apple Cube required moving the software to MacOS. We chose MacOS-X because it is essentially a Unix system, which would facilitate porting the system. However, we faced many problems, such as missing drivers for the video camera and remote control, and constantly upgraded to new versions of MacOS-X in the hopes that some bugs would have been fixed. (Sometimes they were, sometimes not.) We also based the design on Roussel's video library, which was being updated at the same time. So we benefited from new features, but were slowed by having to recompile and do minor redesigns.

We also worked hard on making the system more robust and maintainable at a distance. Situations where the network becomes inaccessible (DSL ISPs often shut down the connection once a day), or where the camera stopped working, where difficult to address. We set up the Cubes so we could access them through the Internet from our lab. This allowed us to remotely maintain them, to a certain extent. The Cubes were also set up to start the videoProbe software automatically on startup (since the videoProbe was going to be installed without a keyboard nor mouse, it was important that the families could restart it without our assistance).

Packaging

Considering the variety of devices and each of their interconnecting cables, we had to develop a packaging design that is compact, non intrusive and simple to handle. We structured the technology into two units: the Apple Cube and its power supply and a customised rectangular box that houses all of the remaining equipment: screen, speakers, hub, and camera. These units are connected via a covered lead, that includes the video, power and USB cables (figure 2.3.1).

The unit was designed to be usable in a variety of different spatial configurations within the families' homes. The box can stand alone, with no external support and placed on any item of furniture. A hole in the back allows it to be mounted onto a wall, like a picture frame. The unit may also lie flat on its back, so that it can be used for message/drawing applications. (The LCD screen is also a Wacom touch-sensitive tablet.)

We designed the display to exploit the high quality of the screen and the video camera, which enables us to display high-quality colour images with a resolution of 800x600. If the videoProbe is not triggered and in reactive mode the screen is black. If it is in recording mode or display mode, the camera image is displayed at full resolution. The remaining parts of the screen and the rest of the box are covered with white plastic. We decided to

Figure 2.3.1b: videoProbe display and camera.

keep the visual design of the videoProbe as simple as possible, to blend in with any decor. The white plastic works well, since it does not attract much attention and naturally disappears into its surroundings when the system is not active. Once an image appears, however, the packaging highlights it, framing it with a glowing white semi-transparent band.

The camera sits on top of the videoProbe screen, similar to a webcam sitting on top of a computer monitor. We wanted family members to be able to point the camera in any direction in space, so we created a notch filled with plastic foam on the top of the white videoProbe box. This makes it easy to lift up the camera, rotate it and then fix it into the desired position. The camera can be focused by hand and has a wide range, including objects that are only millimetres away. We provided a long cable, to enable family members to take the camera out of the videoProbe altogether and take close up shots of objects, text or other images nearby (figure 2.3.2).

To simplify the use of the videoProbe we created a custom-made graphic design for the remote control (figure 2.3.3) to indicate the different functions of the buttons. Our earlier tests showed that even the few tasks executed by the remote control can be confusing. It is not obvious how one can put an image into the album, or delete an image from the album, and these actions are not clearly related to culturally-established VCR control iconography, such as <<, >, >>. Note that users also face these problems when attempting to manipulate stored images on commercial digital cameras.

Conclusions

The first conclusion to draw from trying to install the videoProbes is that it was significantly more difficult than we anticipated, particularly in dealing with aspects relating the network. We were pleased with the packaging and the general enthusiasm of the family members, who really wanted to try out a new technology. However, we are still waiting to collect the data we were originally hoping for. Now that summer holidays are over (most of the families were gone for a month or so in July or August) and with additional experience in identifying network

Read more about the use aspects at 1.4, "Family use experience of the VideoProbe in France"

Figure 2.3.2 (three left): Using the camera of the videoProbe.

Figure 3: (two right) Design of the remote control.

problems, we will try to reconnect the current set of videoProbes.

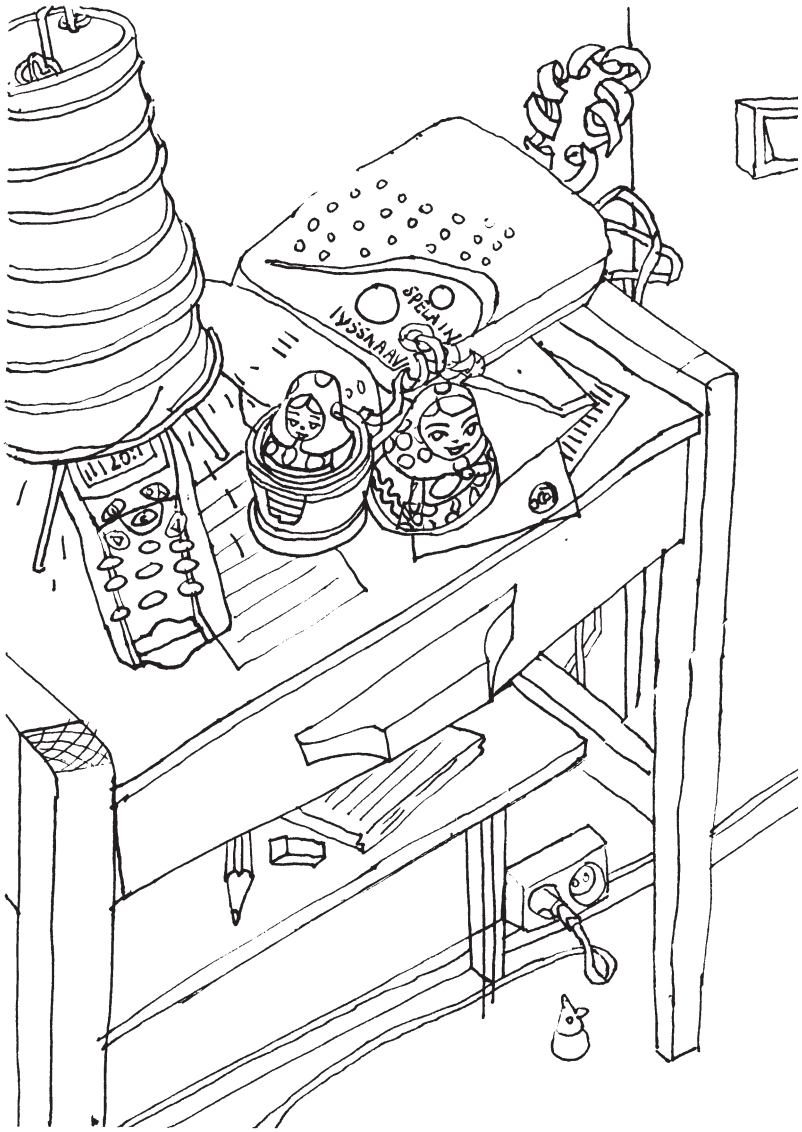
The second conclusion that we draw from this experience is that networking remains a major problem and is simply not in a state in which ordinary family members can use it. Not only is it unreliable, but it requires a high level of technical skill in order to diagnose problems and make things work. Non-technical families are excluded from many of the potential benefits of networked computing because of these problems.

At the beginning of this project, one of the issues was to define a problem to solve: to understand what kind of technology is needed and useful for families. The primary outcome of our experiences thus far with the videoProbe, backed up by our interviews and the scenarios from the workshops, is the crystallization of what we believe is the next major prototype to develop. Although many researchers are working on ubiquitous technologies, many destined for the home, few if any are working on the design of the infrastructure that would make such applications realistic. Systems that are explicitly designed to support interconnectivity among people outside of work settings seek to provide universal access to everyone, either via the telephone or the internet.

We have come to the conclusion that family members need an accessible infrastructure that enables a wide range of services, including but not limited to technologies like the videoProbe and the messageProbe. Systems that connect family members or small groups of people, such as Mynatt's family portraits (Mynatt et al. 2001) or the early media space work (see Bly et al. 1993 or Mackay, 2000 for reviews) need closed, secure networks that are easy for anyone to control. Although we see increasing numbers of such systems in laboratories, design workshops and museum installations, they never make it to real people in home settings: The current environment is far too difficult for ordinary human beings to manage.

We believe we can simplify the problem, and thus provide a usable solution, by shifting some of the underlying assumptions that currently make networked systems so complex. First and foremost, we need small networks. We do not need them to scale to the size of the internet, or even to that of a corporation: these networks are limited by the number of people that a family is close to. Once we know the network is small, we can use a tangible interface that gives simple access to everyone, including children and non-technical adults. If people can quickly and easily establish a network that supports communication within their families, we can then offer a wide variety of "information appliances" or communication appliances that servedifferent purposes, from true needs to purely whimsical and everything in between. We can finally start taking advantage of the many clever and thought-provoking devices that sense changes in the environment and display information to users in new and intriguing ways.

This suggests that the next major step for interLiving is to create a prototype "FamilyNet" and to build a set of applications that show the different ways that such a service can be used. We are currently planning to build three new prototypes in France: a fuzzy calendar system, a sound application, an extension of the videoProbe called MirrorSpace, which should all act as applications accessible via the FamilyNet.



3 Prototypes

3.1 FamilyNet

The goal of FamilyNet is to provide families with an easy and secure way to create and maintain private networks. In particular, these networks are independent of the Internet and immune to spam, viruses and other casualties of the Internet era. At the same time, FamilyNet uses the Internet infrastructure for maximum accessibility.

The design problem involves two major challenges: how to create an interaction that establishes and configures small, closed networks that even young children and non-technical adults can use, and how to create a secure, underlying infrastructure that can be readily developed and distributed by major telecommunication and cable companies.

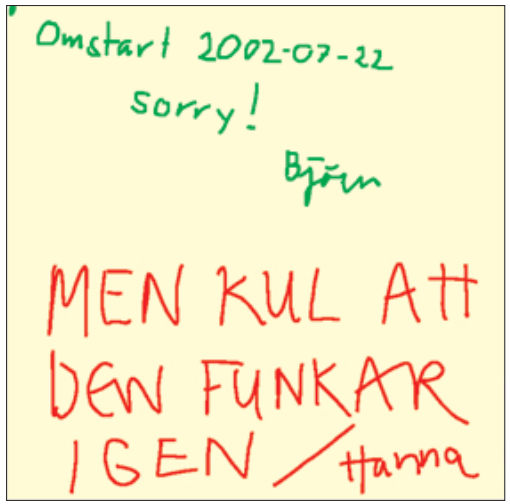
The FamilyNet infrastucture itself is independent from the actual services it gives access to, providing extensibility for future services. The probes we have developed so far are examples of services that could be accessed through FamilyNet. FamilyNet is designed under the assumption that each network will be relatively small. However, the number of networks may be huge. This asymmetric scalability is a key aspect of the design of the system.

Another key design influence is our understanding of the types of network topologies that families are likely to create. Our work with the InterLiving families has demonstrated the need for household-to-household services, such as those afforded by our videoProbe and messageProbe, as well as more personal, even intimate links between individual members, e.g. a couple or a child and his grandparent. In addition, the overall topology is not a set of disjoint networks but rather a collection of overlapping networks. For example, a nuclear family may have a network which includes the close relatives of each parent, but those relatives are unlikely to be part of a network with each other. For example, if I set up a network in my home that includes my parents and my parents-in-law, it must not imply that my parents and my parents-in-law will be on the same network. This is especially important today where there is a growing number of recomposed families where the “rules” and patterns of communication are complex and change over time.

The challenge then is to design a technology that is easy for families to configure and at the same time secure, to protect their privacy. The implementation of FamilyNet relies on two sets of technologies: smart cards and public-key cryptography. Each family home will be equipped with a terminal used to read and configure the cards. The terminal will be hooked up to the Internet on the one hand, and to the family services (e.g., MirrorSpace, messageBoard, etc.) available in the home. We envision that the terminal plus an initial set of cards can be packaged together with a simple messaging service, as a low-cost plug-and-play sys-

Figure 3.1.1
It seems that the people using the probes had a feeling that they were on a closed network of their own. The Greens got slightly surprized to see this message from the researcher Björn after a restart when he had to start over with a new log file, i.e. a blank screen.

"Restart 2002-07-22, sorry! Björn"
"But fun that it works again/Hanna"



tem. Families could then choose additional services that meet their particular needs.

Smart cards (or tagged personal objects) provide a tangible interface to the network. For example, I can give my sister access to a service such as the MirrorSpace by handing her a card that represents her right to access this service. As long as her card is placed on her terminal, she has access to the service. As soon as she removes the card, the service is discontinued until the card is put back. We are exploring both classical smart cards that have a micro-chip on them, as well as a lightweight version based on RFID tags, which has the advantage of being readable at a distance. RFID tags can also be very small and could be put on various substrates, including everyday objects such as a postcard, a mug or a watch.

Public key cryptography is used to ensure the privacy and security of the networks. Each user of the FamilyNet has a personal card used to authenticate that person. Each terminal also has a card used to authenticate the terminal (similar to the SIM card of GSM cell phones). Each card issued with a FamilyNet terminal contains the identity of the persons or terminals that are granted access to the service embodied by the card. Using public-key cryptography, it is possible to guarantee that access to a service is granted only to authorized users, with minimal interaction. For person-to-person services, the users would have to put the service card on the terminal and authenticate themselves using their personal card. For household-to-household services, the users must physically place the service card on the terminal. The physical nature of cards and the design of the terminal provide an easy way for all family members, even those not technically-inclined, to see and control which services are available. This is similar in spirit to the marbles of D. Bishop's answering machine.

What's in a card

We envision different types of services: household-to- household, such as the MirrorSpace or MessageBoard, person-to-person, such as a messaging system between a couple, and event-based, such as a temporary network to organize a birthday party. We can create any these services using two kinds of cards:

- authentication cards, used to authenticate individual people as well as locations (i.e. terminals).
- service cards, used to describe access rights to a given service by a set of people or locations.

Authentication cards are smart cards containing a chip (like a French credit card). This is necessary because they hold a private key that must be stored securely on the card. Personal authentication cards are read by sliding them in and out of the terminal. For added security, they may also require the user to enter a PIN number. Location authentication cards are held inside the terminal and are not meant to be manipulated by end users.

Service cards can be implemented either with smart cards, or with RFID tags. We prefer the latter as it opens a wider design space, including attaching RFID tag to various objects, such as a mug,

broom or postcard. Since RFID tags can be read at a distance, they can also be worn, e.g. on a watch. Service cards are meant to be placed on the terminal or within its reading range, for as long as the service needs to be accessed. Some cards will be left permanently on the family's terminal. Others will be used for short periods of time, i.e. during a particular event. The system is open to adaptation by users and we anticipate that they will invent their own convention and usage patterns.

Public-key cryptography

Cryptography has a variety of applications in networking systems. For FamilyNet, we are especially interested in authentication, i.e. making sure that the emitter of a message is who she claims to be, and security, i.e. making sure that a message cannot be intercepted or tampered with.

Cryptographic systems rely on keys used to encode and decode messages. These keys and the encoding/decoding algorithms are designed in such a way that it should be impossible, or at least computationally very expensive, to decode a message unless you know the key.

Symmetric systems rely on the same key to encode and decode a message. These systems are efficient (encoding and decoding is fast), but they can only be secure if both parties know the key. The challenge then is to exchange keys securely.

Asymmetric systems rely on a pair of keys such that a message encoded with one key can only be decoded with the other key. In addition, it is impossible (or rather, computationally very expensive) to compute one key from the other. Asymmetric systems are the basis of public-key cryptography: For each pair of keys, one is kept private by its owner, the other is made public (e.g. by putting it in a public directory). In order to sign a message, the emitter encodes it with her private key. Any receiver can use the associated public key to decode it. Successfully decoding the message proves that it was issued by the owner of the corresponding private key. In order to send a message securely, a sender encodes it with the receiver's public key. Only the holder of the corresponding private key will be able to decode it.

Authentication and security can be combined: the sender encodes the message with her private key, adds her identity to the encoded message, and encodes it again with the recipient's public key. Only the recipient can decode the message, using his private key. The decoded message contains the sender's identity and the message encoded with the sender's private key. This allows the receiver to retrieve the sender's public key and decode the message.

The main drawback of asymmetric systems in general and public key systems in particular is that they are slow because the encoding and decoding algorithms are more complex and computationally demanding than those of symmetric systems. Therefore, practical applications, e.g. SSH, use a combination of the asymmetric and symmetric approaches. The slow, asymmetric system is used to exchange a symmetric key that is valid only for

the duration of the session. The rest of the session uses a fast, symmetric algorithm.

This solution appears to be ideal for FamilyNet: the terminals located in each household communicate with each other using a public key (asymmetric) system. Once access to the service has been granted, a symmetric key is generated and passed to the service, which uses it for its session. This has the major advantage that services never see the public and private keys of the asymmetric system. Since services could be provided by any third party, it makes the system more robust to attacks by Trojan horses or other non-trusted services.

The main point here is that cryptographic systems allow us to create a secure system while keeping it easy to use. Users simply exchange cards; they hold one private card that should be treated with the same level of confidentiality as their credit card.

Service independence

A key aspect of FamilyNet is that it must be independent of the actual services. This is critical for the extensibility of the system. The services installed at a family home register themselves with the FamilyNet terminal. When the terminal receives a request, i.e. when a card invoking this service is put on a remote terminal, the local terminal authenticates the remote card, generates a session key and notifies the service. The service can implement any policy with respect to access to its resources. For example, a service such as MirrorSpace may require that two sites can interact only if each site is connected with the other (i.e., site A has a card for MirrorSpace at site B and site B has a card for MirrorSpace at site A). A service such as a messaging system may not have this constraint.

We expect services such as MirrorSpace or MessageBoard to be distributed throughout a house, ideally with wireless connections. However with only one terminal, this requires users to move from the terminal to the service before they can use it. We can solve this by placing multiple, interconnected terminals in a single home. Multiple terminals may be useful to distinguish between different locations in the house, e.g. shared spaces like a hallway or the living room, vs. more private spaces like a bedroom. Services could take advantage of this distinction. For example, a person looking at his messages on a messaging service would only see private messages when physically in his bedroom. One of the terminals would be the master one, i.e. would be hooked up to the outside network; other terminals would be satellites of the main terminal, much as home wireless phones that have a base and multiple stations.

Usage scenario: VideoNetwork

Michel and Wendy want to create a video network with their respective parents. For Christmas, they buy a kit consisting of 3 terminals with an integrated video service. Each terminal comes with its location card, which identifies it uniquely, plus a few service cards, preprogrammed to access the termi-

nal's video service. In addition, the package contains a set of blank cards for future use.

Once at home, they plug in one of the terminals, which will become their main household terminal. Since it is the first time the terminal is plugged in, they are asked to give it a name that identifies its location. This information is recorded on the (invisible) terminal's card, together with the internally-generated public and private keys for the terminal. They keep one service card from each of the other two terminals, which will allow them to gain access to these terminals once they are installed. In order to give access to their own terminal's video service by the other terminal, they take two cards from their deck and wrap them with the other terminals.

When Wendy's parents receive their terminal for Christmas, they plug it in, put the card that accesses Wendy and Michel's terminal, and can instantly see pictures taken by their daughter and son-in-law on their video terminal. Michel's mother does the same when she receives her terminal. Note however that Wendy's parents' picture will not be visible to Michel's mother, nor vice-versa, because they don't have each other's cards. Nevertheless Wendy and Michel can see pictures taken by both of their parents.

As it turns out, Michel's brother, Emmanuel, also got himself a FamilyNet terminal for Christmas. Wendy and Michel immediately decide to exchange their service cards so that they can share pictures. Emmanuel has a personal card so when he visits them shortly after Christmas, he can create a service card to access his video terminal from Wendy and Michel's terminal. (If he did not physically visit, he could just as easily have exchanged the card by surface mail.)

Usage scenario: PrivateMessaging

Wendy and Michel travel a lot, and they like to stay in touch. They telephone each other a lot, but because of time differences, endless meetings, and crazy schedules they often miss each other's calls. Since they got their FamilyNet terminal for Christmas, they decide to set up a message service just for the two of them. On Valentine's day, Michel gives Wendy a (red heart-shaped :-) card to access the MessageBoard. The MessageBoard has an LCD screen with a touch-sensitive surface, so that one can draw and write directly onto it.

One week later, Michel travels to Canada and stay with his friend Garry, who happens to have a MessageBoard too. Because of the time difference, it is the middle of the night in Paris. If he waits until the next day to call Wendy, it won't be the middle of the afternoon for her. He decides to leave her a message using Garry's MessageBoard. He puts his heart-shaped card on Garry's terminal. The terminal asks Michel to authenticate himself, which he does by sweeping his personal card in the terminal. Michel writes a nice message and Garry adds a funny drawing. They are interrupted by Garry's kid who are back from school. As they greet each other and start chatting, Michel forgets about the MessageBoard and leaves his card on it.

Two hours later, as they finish dinner, the MessageBoard rings: Wendy, who couldn't sleep, had decided to leave a message for Michel on her MessageBoard. As she puts her heart-shaped card on the terminal, the system notices that both parties are on-line simultaneously, and notifies the other party with a beep. The MessageBoard has turned into a shared drawing area. Shortly after, the phone rings at Garry's: it is Wendy calling.

After this event, Michel notices that the heart-shaped card has a small hole so that it can be attached to a necklace. The terminal can read the tag imprinted on the card at a distance of up to 50cm. Now, in order to access his private MessageBoard with Wendy, Michel only has to approach the MessageBoard. If he is at home, this is enough to authenticate him. If he is at another location, he also has to swipe his personal card. However, he has heard of a new generation of terminals that can also read the personal cards at a distance. Fortunately, Wendy's birthday is coming soon...

Usage Scenario: Birthday Party

Wendy's birthday is coming and Michel wants to organize a little surprise for her. This involves making sure she does not get home before 7pm on that day, so that the house can be set up and everybody be there. Michel decides to use the MessageBoard to help coordinate everything. On his terminal at home, while Wendy is away, he creates a new message area in the MessageBoard and a set of cards to access it. Over the next few days, he gives the cards to the people involved in the surprise.

He has created a (hand-drawn) table on the MessageBoard with everybody's name and what they should do. Over the next two weeks, the table is refined and edited by everybody. Of course, Wendy does not have access to it even though it is stored on the terminal at her own house. Even if she were suspecting something and were somehow able to find or borrow a card to access the messages, she would have had to authenticate herself as one of the authorized users.

Indeed she his suspecting something because Michel is using the MessageBoard more often than usual. (The MessageBoard can also be used to surf the web). But she thinks he is trying to find a baby sitter and making a reservation at a nice restaurant. So when her birthday arrives, she is quite upset that a colleague from work (who was on the group using the MessageBoard) asks her to urgently review a paper he is finishing and must be submitted on that day. This was the trick to hold her up at work, and when she finally gets home at 7:30, she his completely surprised to see all her friends waiting for her and ready to celebrate.

Michel had set up the MessageBoard service to expire on the day after the birthday. After this date, all the messages are deleted and all the cards that were issued to access it have become invalid.

Usage Scenario: Kid's network

Michel and Wendy have two young boys, who often play together (sometimes cheerfully, sometimes not). They each have a GameBoy, which they play both individually and connected together. Alex, the older boy, has been learning lots of GameBoy tricks from his friend Hugo, who also has a FamilyNet terminal at his house. When Alex's brother Matthew is at a birthday party on Saturday afternoon, Alex places his personal card on his home terminal. Hugo is at home, but playing with their mutual friend Eugene. He sees that Alex is bored and offers to play a game of Pokemon at a distance, via their FamilyNet-enhanced GameBoys. They then invite him over to spend the rest of the afternoon together. At 6:00, Alex and Eugene's parents check in to say it is time to come home. Later that evening, Alex and Hugo play a final game of Pokemon on their GameBoys before going to bed.

Every Tuesday, Matthew is picked up from school by his friend Theo's mother and they play together until Michel or Wendy can pick him up at 6:00. Alex is old enough to go home directly and be by himself for an hour and a half, before everyone else gets home. On the other hand, everyone feels more comfortable if he has someone to talk to. Michel's mother lives in Bordeaux, so she cannot just come over. Since she is retired, her schedule is flexible and she welcomes the opportunity to spend one-on-one time with her grandson. When Alex arrives home, the videoMirror detects his presence and displays an image of him to his grandmother (Magnolia) and vice-versa. She greets him and they chat for a while. She asks if he has any homework and he says he has to memorize a poem by Claude Roy. He places the poem in front of the screen and he recites it, stumbling occasionally. She prompts him and gives him some advice on how to pronounce one of the words. After that, he says he wants to play with his Legos. She goes into the kitchen and starts preparing a soup. Occasionally she says something to him or vice versa, as they each go about their regular activities. Michel comes home first and says hi. They chat a bit, and then break the connection. (Note that if there's a problem, Magnolia can contact Michel or Wendy, or Alex can go to the next door neighbor.)

3.2 Door

Fig 3.2.0
The Blue nuclear family members have always expressed their problems or struggle with notes and messages. Here is one of their communicationProbe photos saying:
"The front door would be a perfect place for reminders and messages. A place we should take advantage of."

The Door prototype is an effort to improve the communication and scheduling of activities among family members. At the start we concentrate on communication between members living in the same household. (see 1.5)

In contrast to the Calendaring effort (see section 3.5), which in a way looks at the semantics of scheduling, this particular effort is more focused on the user interface and means to interact with scheduling entities. But at the moment we do not know where the Door leads at the end, since it is a cooperative effort together with the families.

The name Door comes from the fact that we at first considered placing it on the inside of the front door of the household. And in both the first video and paper prototype versions we placed it there. Later we have re-considered this and the placement is not that obvious and we will discuss and test this further with the families in forthcoming versions.

Background

In the discussions with the families, better tools to communicate and organize activities have been mentioned as essential or even required. The activities could be individual or between family members, occasional or scheduled, regularly repeated or just known several weeks in advance and maybe from bodies outside the household, as schedules for school or the hockey team.

There are obvious relations to the Calendar but the Door effort is more focused on the propagation and delivering of messages between family members, the packaging. We also try to find means to get the computer to disappear as much as possible but also consider the best user interface for the particular activity.

Even though we have planned for email and web interfaces, which will classify the application as belonging to different place/same time, our primary focus at this stage of development is on same place/different time. That is; the primary aim is to in co-operation with our families investigate and develop a useful interface for smooth and rapid exchange of information, maybe of scheduling character, between members of a family.

Foundation, Ideas, Requirements and Limitations

The foundation of the Door is communication of scheduling entities. We look at how all kinds of media could be used to enhance and/or simplify that communication. At first we plan for handwritten drawings with text, a la messageProbe, but in forthcoming versions we will investigate text written by typing devices, sound, video, providing doc-

ument scanning possibilities, voice recognition, voice to text transformations, controlling the device by gestures, and so forth.

AN OPEN DEVELOPMENT PROCESS BASED ON COOPERATIVE DESIGN

The researchers have our own ideas about the design but we carefully try to avoid pushing them onto the families. We still believe that we co-operatively could find novel and hopefully better and funnier ways to both approach and, at the end, solve our problems.

REQUIREMENTS ON THE INFRASTRUCTURE

Ideally we would have wireless Internet with a bandwidth of at least 5 Mbit/s. But this is not the case and we have to adapt. In some of the families we have 512 Kbit/s and in others the only possibility is an ordinary modem or GPRS. Further if we want to include cellular phones this restriction is even more critical. Our main development partner, the Blue family, has at the moment only access to an ordinary modem and GPRS. Therefore we try to develop the infrastructure and communication layers in such a way that we could use the prototype even in these settings. Since a lot of traffic only takes place within the household we also try to base the application on a model where both the server and clients are running on the same hardware within the household. Thereby we also hope to provide a solution to problems with integrity and limited bandwidth. However, if possible, in a not too distant future or within other households, we want to exploit a fully developed broadband. For instance, even if possible with limited bandwidth, we do not want to restrain the possible smoothness and abilities to direct feedback while communicating audio, pictures, and video and other more bulky communication entities. But in cases where high bandwidth is not possible we still want to be able to provide as much services and commonalities from the more full fledged services as possible.

SOFTWARE REQUIREMENTS

We try to build the software of the Door, as far as possible, on standard software, running on most types of common platforms. The software must also support rapid analysis and design (RAD), provide tools supporting development of graphical user interfaces, and support Internet use.

SOFTWARE FOR THE FIRST VERSION

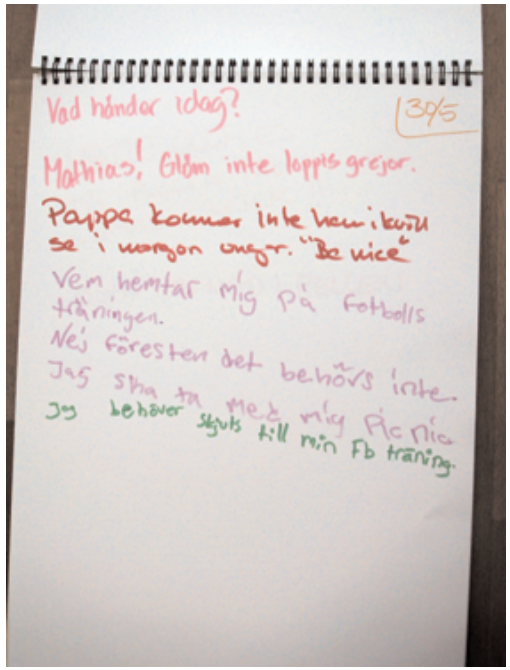
The first version will be developed with VisualWorks\Smalltalk, version 7, from Cincom.

SOFTWARE THAT WE CONSIDER FOR FUTURE VERSIONS

In future versions we probably need other software as well. At these early stages we have already considered:

- Squeak (Kay 2002) with its provision for both multimedia, distribution and to some extent visual programming
- A data base of relational type, as DB2, Sybase, or Oracle, or an object oriented distributed one as GemStone
- Nuance (Nuance 2002) software for voice recognition and text to synthetic voice

Figure 3.2-1 A snapshot of a page from the first Door prototype.



- Java to be used to interface mobile devices as PDAs and cellular phones

HARDWARE REQUIREMENTS

To enable for wider spreading we develop the base version of the Door on standard hardware components: a standard PC or MAC,a touch screen, a camera, a microphone and loudspeakers and/or headphones.

Ideally for remote accessibility an Internet connection with high bandwidth should be available. But, as mentioned in the section *Requirements on the Infrastructure* above, at the moment it is not possible to provide all the households within our main target family with this facility. Therefore, in those cases, we use a GPRS or modem connection instead.

Evolvement and Different versions

Even though the prototyping of the Door is work just recently started we have in quite a short time evolved through several different versions and prototypes of the application.

INITIAL DISCUSSIONS AND IDEAS

During the workshops and meetings with families, and as a result of discussions among the researchers, a seeding for a communication platform intended for communicating and scheduling within a family has been made. In particular the Blue family asked for a communication platform like this. Therefore, we are in the process of evolving the idea co-operatively with the Blue family, by means of discussions and both paper based and computerized prototypes.

THE VIDEO PROTOTYPE VERSION

During a Disappearing Computer workshop/Atelier the idea of a "family hub" was developed further (see section 4.1). The effort was also named "The Door" as a result of placing the central communication area on the front door. We gratefully acknowledge Tim Diggins from the DC project MiME for contributing in the development of this version of the Door.

We made a fictive family with the following members:

The Bloom Family:

Parents Roberto & Stina
Children Billy & Anna
(Grandpa)

Then we discussed what should happen and defined a typical scenario for a day in the Bloom Family's life. Finally we recorded the video.

In the table below each row shows an interaction with the Door. The entities in the column Illustration shows the video clip for the particular event and in the column Transcription of the content that appears on the Door is shown.

THE FIRST PAPER VERSION

To investigate the domain and collect requirements for the application we had a meeting with the Blue family. The main aim was to discuss their overall communication patterns, a reasonable interface

and possible locations for the communication centre. We also demonstrated the video version of the Door.

In these discussions we found that the placement of the prototype at the inside of the front door was a reasonable one, and at the moment perhaps even the best. The front door is passed while leaving or entering the house or while going between different locations within the house, such as from the kitchen to the living room, the basement, or to any of the bedrooms.

This version consisted of a block of paper, some coloured pens, a simple Polaroid camera and a simple voice recorder. We put the block of paper on the inside of the front door. Then we asked the family members to try to communicate their different activities by writing on the block, give voice messages, via the tape recorder, or take pictures, via the Polaroid camera, and attach them to the block (see figure 3.2-1). To distinguish between family members we asked each member to choose their own coloured pen for writing messages.

However, after a while the members, mainly by accident or in a hurry, confused the pen colours. As a result the family saw no meaning in continuing to use separate colours for each individual. Therefore the colours were not anymore a good indicator of who has written a certain message. The family understand who has written a certain message by alternatively using the context, the handwriting or a combination of the two. We ourselves could also in many cases conclude who has written what but to be sure we also asked them this while we were

Illustration	Transcription
	**08:00** Roberto, Stina, Billy, Anna are home Anna: Hockey Grandpa: coming to dinner Roberto Leaves the House Leaves a message on the door Voice message from Roberto [Play] Stina, Billy, Anna are home Anna: Hockey Grandpa: coming to dinner
	**11:00** The door has recorded some events Some mail is delivered No one is in Some mail has arrived Anna and Stina have new e-mail Anna: Hockey Grandpa: coming to dinner
	**13:00** Billy Leaves a message via phone from his friend Nisse's household No one is home Voicemail from Billy [Play] Some mail has arrived Anna and Stina have new e-mail Anna: Hockey Grandpa: coming to dinner
	**16:00** Billy comes home & goes out again... as he leaves... {He leaves a voice message at the door "I'm going out to play football."} The door prioritises the new message over the old voice mail No one is in Voice message from Billy [Play] Some mail has arrived Anna and Stina have new e-mail Anna: Hockey Grandpa: coming to dinner **17:00** When Stina comes home she plays Billy's message {By pushing the button on the door}

Figure 3.2-2 A cross-reference. The photo of the note about the Brass Band was taped into the calendar on May 23. The event itself was May 28.

interviewing them about their general impressions of the probe. However at this stage we did not use the colouring information explicitly and it was rather a factor as any other while discussing the whole prototype as such.

The prototype was a success in the sense that the family members used it frequently for communication and remembering events of various kinds. Nevertheless, one particular problem with this version was how to handle recurring events. The problem was that the prototype was made in such a way that you have to flip a page for each day. The family solved the problem of such recurring events alternatively by copying the text to different pages or in some occasions by writing a kind of cross reference mark accompanied with a short reference text explaining where to find the origin or the expanded version of the note (see figure 3.2-2).

THE SECOND PAPER VERSION

We had a wish to make the application both flexible and fun to use. The reason for this was to a great extent inspired by the rather different usage of the MessageBoard probe within the Green family, and of course as a result of evaluation of the previous prototypes with the Blue family. Therefore we decided to implement a second paper prototype based on Post-It notes, in contrast to the previous more limiting binder based version. For better quality of the pictures the Polaroid camera was replaced with an ordinary camera.

In this paper version we did not have any specific requirements for having it placed on the front door. In this way we could avoid what the Blue father said when we discussed the placement; “If we have it on the front door all our friends and visitors could immediately see what is going on in our family!” This, somewhat intriguing, drawback could most likely be avoided in a computerized version, since it could more easily (maybe automatically) be turned on or off.

Actually the Blue family household that tried this prototype placed it in an even more central area than the front door. But not as accessible to outsiders as the front door. They put the notes on a framed poster covered with glass on the wall just above a drawer where they usually leave lots of stuff. (figure 1.5.4) This area was just three meters away from the front door, still located in the hall, but nearer to both the kitchen and the bedrooms. Earlier, when the prototype was located on the front door, you could more easily miss it on your way to the basement or the bedrooms. But with this new location it was almost impossible to miss it and, further, the family said that they more likely updated or looked at it even if they at the moment had some activities in the kitchen. Actually you saw the prototype if you stand in the area of the oven, refrigerator or the sink.

USAGE OF THE PROTOTYPE

To summarise some of the most essential findings of the Blue family’s usage of this prototype:

- Notes were used quite extensively and by all members in the household.
- Having the prototype located where one often passes it and could be aware of it while situated in

other areas in the home is good. And if this location also caters for the household's integrity against guests and other kinds of temporal visitors it is even better.

- The family organised the notes in such a way that recurring events were placed to the left and more temporary ones to the right of the "board".
- The semantics of coloured notes was not used much and differently coloured pens were almost not used at all, perhaps based on experiences from the previous prototype. However they expressed that they would like such facility in a computerised version.
- The family also asked for a way, to at least semi-automatically, date the notes. So this facility was something that we decided to discuss and explore further in the forthcoming computerized versions.

THE INFRASTRUCTURE AND THE FAMILY NET

In parallel with the development directly in co-operation with the families a development of the basic infrastructure providing the door is progressing. In particular parts of the FamilyNet and requirements on its households and members in relation to what is required as a basis for the Door are evolved. The intention for this part of the FamilyNet, foremost aimed at supporting the door, is to create a basic platform defining roles for members within different households and relations and possible communication surfaces between the various members. At these primary stages of the Door development we do not address authentication or security. These issues are more extensively discussed in the FamilyNet section of the deliverable (see section 3.1).

Purposely the development of the network has been rather pragmatic so far. The main aims have been to:

- Support the current computerised prototype with a reasonable infrastructure
- Use it as a tool for further explorations of family relations and as a mental construct for discussing various software solutions.

THE DESCRIPTION OF A HOUSEHOLD

A household is described by an XML document. The document definition is made in such a way that information of a certain aspect in the household could be situated locally, on a server reachable via Internet or a mix between these ways.

The Document Tag Definition (DTD) of a household looks as follows:

```
<!— household.dtd —>
<!— DTD document for
householdNEWProposal.xml —>

<!ELEMENT household ( nameOfHousehold,
address, householdContactInfo, member* )>
<!ELEMENT address ( streetName, number, city,
zip )>
<!ELEMENT householdContactInfo (email,
webaddress?, phone*, IP? )>
<!ELEMENT member ( name,
socialSecurityNumber, roleInHousehold, presenta-
tion, contactInfo?, samples?, greeting? )>
<!ELEMENT name ( christianName+,
familyName, nick )>
```

Figure 3.2-3 The second paper prototype.

```
    <!— Each member must choose one role in the
household. Choose the one that fits best. —>
    <!ELEMENT roleInHousehold EMPTY>
    <!ATTLIST roleInHousehold role ( parent | father
| mother | daughter | son | child | relative | grand-
parent | friend | guest | lodger | cat | dog | bird | fish
| pet | other ) #REQUIRED>

    <!— The picture is the URL of a picture of the
member. Short info is a URL with a very short
description of the member. The infoUrl, if present,
is a more extensive description of the member. The
icon, if present, is a small picture or icon that could
be used to present the member in lists etc, if not
present an icon is automatically generated from
the picture. —>
    <!ELEMENT presentation ( picture, shortInfo,
infoUrl?, icon? )>

    <!— At the moment one could only choose one
cellular phone number, one email and one web
address, but none of them are compulsorily —>
    <!ELEMENT contactInfo ( cellularPhone?,
email?, webaddress? )>

    <!— The samples are URLs with respectively
sample —>
    <!ELEMENT samples ( voice?, handwriting? )>

    <!— The greetings are URLs with respectively
greeting —>
    <!ELEMENT greeting ( greetingText?,
greetingAudio?, greetingVideo? )>

    <!ELEMENT nameOfHousehold ( #PCDATA )>
    <!ELEMENT streetName ( #PCDATA )>
    … similar descriptions of all the rest of the ele-
ments …
```

A family could be defined in a corresponding XML document. Below follows an excerpt from the test family we have used for initial tests of our software and infrastructure:

```
    <?xml version = “1.0”?>

    <!— Household in  XML  —>

    <!DOCTYPE household SYSTEM
“householdNEWProposal.dtd”>
    <household>

<nameOfHousehold>Test</nameOfHousehold>
        <address>
                <streetName>Gatan</streetName>
                <number>123</number>
                <city>Staden</city>
                <zip>12345</zip>
        </address>
        <householdContactInfo>

<email>brundoor@nada.kth.se</email>

<webaddress>http://www.nada.kth.se/~brun-
door</webaddress>
                <phone>00-12345678</phone>
```

```
                <phone>00-12345677</phone>
                <IP>127.0.0.1</IP>
        </householdContactInfo>
        <member>
                <name>

<christianName>Karl</christianName>

<familyName>Brun</familyName>
                        <nick>Kalle</nick>
                </name>
                <socialSecurityNumber>630303-
XXXX</socialSecurityNumber>
                <roleInHousehold role = “father”/>
                <presentation>

<picture>file:///C:/Kalle.jpg</picture>

<shortInfo>http://www.nada.kth.se/~kalleDoor/sho
rtInfo.xml</shortInfo>

<infoUrl>http://www.nada.kth.se/~kalleDoor/info.x
ml</infoUrl>

<icon>http://www.nada.kth.se/~kalleDoor/myIcon.j
pg</icon>
                </presentation>
                <contactInfo>
                        <cellularPhone>070-
1234567890</cellularPhone>

<email>kalleDoor@door.nada.kth.se</email>

<webaddress>http://www.nada.kth.se/~kalleDoor<
/webaddress>
                </contactInfo>
                <samples>

<voice>http://www.nada.kth.se/~kalleDoor/saying
Hello.wav</voice>

<handwriting>http://www.nada.kth.se/~kalleDoor/
writingHello.gif</handwriting>
                </samples>
                <greeting>

<greetingText>file:///C:/KalleGreeting.xml</greetin
gText>

<greetingAudio>file:///C:/KalleGreeting.wav</greeti
ngAudio>

<greetingVideo>file:///C:/KalleGreeting.mp3</greet
ingVideo>
                </greeting>
        </member>
        <member>
                <name>

<christianName>Elisabeth</christianName>

<familyName>Brun</familyName>
                        <nick>Bettan</nick>
                </name>
```

```
                <socialSecurityNumber>750621-
XXXX</socialSecurityNumber>
                <roleInHousehold role = “mother”
/>
                ... etcetera ...
        </member>
        <member>
                <name>

<christianName>Per</christianName>

<familyName>Brun</familyName>
                        <nick>Pelle</nick>
                </name>
                <socialSecurityNumber>950628-
XXXX</socialSecurityNumber>
                <roleInHousehold role = “son” />
                ... etcetera ...
        </member>
        <member>
                <name>

<christianName>Sofia</christianName>

<familyName>Brun</familyName>
                        <nick>Pyret</nick>
                </name>
                <socialSecurityNumber>981221-
XXXX</socialSecurityNumber>
                <roleInHousehold role = “daughter”
/>
                <presentation>

    <picture>file:///C:/Pyret.jpg</picture>

    <shortInfo>http://www.nada.kth.se/~pyretDoor/sh
    ortInfo.xml</shortInfo>
                        </presentation>
            </member>
        </household>
```

Note that a lot of the fields are optional. As an example some fields are excluded in the part describing the daughter, Sofia.

DEFINING THE COMMUNICATION BETWEEN HOUSEHOLD MEMBERS

Seen from a household's communication point of view a message is perhaps the most essential artefact of the Door. A message contains, first and foremost, the content to be transmitted But also information about the sender, the possible receivers and rules for when and how its visual appearance, e.g. in form of a note. We conceive that in coming versions of the Door a message would also contain a lot of other rules and relations.

Since this is work in progress we do not have any definite answers to what kind of meta information such a message would contain. But still we want something to start working with. However in order to develop the infrastructure we have started this definition process. As inspiration we have looked at ordinary mail handling protocols as SMTP (SMTP 1982, SMTP 1995) and IMAP (IMAP 1996) and expanded on some particular issues specific to the FamilyNet.

A MESSAGE

We have made a draft proposal of what kind of information that should be included in a message in order to provide for family scheduling activities.

A message is described by

A *sender* to be able to identify the origin of the message

A *receiver* of the message, possibly defined with wild cards

E.g., if the receiver is Black.*.mother the message will be sent to all mothers in the Black family

A *time stamp* to identify the creation time

Type and importance to distinguish different kinds of messages from each other

Visibility rules that tell when the message should be visible and for whom.

E.g., the message could be visible for other users than the receiver or alternatively the message could be seen by all but a defined group

Expiration and *Take down rules* telling-when will the visual appearance of the message will be removed, who could take down the message, etc

E.g. the message will be visible until all fathers had seen it but no longer than three days, the message will also be removed if a message of overriding type is received

Content the body of the message

Attachments could be added to a message

Read by, who have read the message

Several of these *options* could be excluded or take on default values.

A message could also carry information considering the bare backbone of the FamilyNet such as describing the particular cryptographic protocol in use, the IP-address of the sender, and so forth.

TECHNOLOGIES

SOFTWARE TECHNOLOGIES

We look at different possible technologies for providing seamless integration into the web, email and other external bodies. In this investigation we address robustness, availability and bandwidth.

HARDWARE TECHNOLOGIES

In the development of the probes we found that touch screens with interaction by means of a dedicated pen both smoothed and enhanced the handling and interaction with the application. The choice of these devices also made it possible for us to hide traditional hardware as mice and keyboard. Therefore, we have decided to develop the Door with touch screens and even take the concept one step further and use screens that provide input by means of fingers. However the latter will not exclude the possibility that we will use pens and other interaction techniques as well. We also need a camera and a microphone to be used for snapshots, audio communication, video, document scanning, etc.

THE CURRENT COMPUTERIZED VERSION

Up till now the efforts spent on the software have been focused on the infrastructure. Therefore the

computerized versions have so far only been intended for developers, in particular for developing the infrastructure and try various techniques and possibilities.

The main efforts in the software constructions has led to two very simple test versions of the door:

1. A list based version founded on MIME, SMTP and IMAP
   We exploit ordinary email to deliver and read messages. The graphical user interface is just a simple list view, some fields and some buttons. Further, most of the interaction has been tried and taken place by automatically running tests, completely written as scripts in a programming language.
   The family net is defined by means of XML and the whole application is running in memory. Later we plan to use non-volatile mediums as databases or files to store persistent data. However some information, as messages/notes, are stored by directly exploiting IMAP.
   In short; in this version the intention and focus is to develop an infrastructure and develop the parts of the family net required for the Door.
2. A Distributed drawing editor
   All clients have the same view. All changes are transmitted to all others. A zoom in one platform's interface results in a zoom on all the others', etc.
   The intention, besides playing with various interaction techniques, is also to test requirements on bandwidth and various higher-level protocols for distribution.

During the development process we have started to work on another prototype, the InkPad (see section 3.4). At least the drawing editor part of the door will be co-developed with the InkPad, which in fact, as defined now, "is just" an advanced distributed drawing editor.

The Development Process

Since communication and co-ordination seem to be crucial we have further discussed this problem within the research group and with the families. We have briefly investigated what is made in the probes and other prototypes. To be able to implement the Door in software we also have started designing an infrastructure defining a household, its members, their roles and communication between them.

INFLUENCES FROM TECHNICAL PROBES

At the beginning we did not really have any influences from the technical probes. But as the paper prototypes evolved we realised that an interface similar to the messageProbe would perhaps be the most appropriate one with its relaxed and fun manner of communicating content. The abandoned audio probe also gave us some inspiration, even if not as a probe as such, but from the requirement analysis where we found a lot of different possibilities to add voice recognition, synthetic voice, seed-

ing the idea of using voice notes as an important means of communication (see Deliverable D1.2).

RELATIONS TO OTHER PROTOTYPES

The core problem of the Calendar (section 3.5), i.e. scheduling activities, is of course of most interest for the Door as well. Even though we in this particular prototype focus more on the user interface and abilities to use various kinds of media and interaction techniques.

There is also an obvious relation to the FamilyNet (section 3.1) since we want to exploit this network for the Door as well.

The evolvement of the MirrorSpace (section 3.3) prototype started at about the same time as the work with the Door started. The MirrorSpace has not influenced the Door directly so far. But in the future we intend to able to exploit the MirrosSpace's abilities to provide for video, awareness and communication.

During the work with the Green family we have started to develop a new prototype, the InkPad (section 3.4). After discussing both the prototypes we found that the infrastructure and basic structure of the two are very similar. Therefore the InkPad and the Door will to a great extent influence each other and major parts of the development will take place in common.

SOFTWARE DEVELOPMENT WITH STORIES

Fundamental to the developing process are the division of the requirements into tiny stories describing each and every one of them (Beck 1999, Jeffries et al 2000). A story is a minimal description of a certain requirement, functional or not, of the system. After the stories were written each of them was evaluated for validity and importance. In the first iteration the ones most precious or important for the infrastructure were chosen. These stories will be under continuous evaluation, reconsideration, and complementation during the whole development process. As said the stories chosen in the initial iterations were more related to the infrastructure than the user interface. The user interface will be evolved in co-operation with the Blue family. However, later on, before implementation, we will try to conceptualise our discussions and more directly address stories for the user interface as well. But at the moment our software engineers mainly use stories internally. They are used to find out requirements, limits and possibilities for the computerised versions.

AN EXCERPT OF STORIES

At the moment we have more than 40 stories, here we show an excerpts of them. All are very sparsely written, aimed at further development and discussions, and some of them are from early iterations as well.

1. (also see story 35) Create family with names and roles.

Attach to household.
Picture/graphical representation

2. Leave a message.
a) Mail boxes for family, household, member, door (?)
Leave message to any of the above categories.

b) A message could be text, sound/voice, handwritten, other media, or any combination of these forms.

A message is an object with some information (text, voice, etc), sender status (from, where, when), importance (urgent, normal, xxx, expiration time), reception status (read by at...), declination rules (removed if read by X, removed if seen by at least N members, removed if older than D)

c) Message icon - indicating media type (and maybe importance)

d) [LATER] also consider email and news as mail boxes

3. Get status/message list. Keep calendar of events.
{split 1}

a) Get status/message list.

Make system aware of your presence (pushing a button or [later] radio tag), voice identification

- The system informs the user that there are messages.

Read message-mark it as read or leave as is. Mark the message as read by you or by the whole household (taken care of..). In the former case the message is placed in your personal "handled box" {name??} in the latter it is marked as read by you but kept in the household's in box

b) Keep calendar of events.

4. React to outside events, email to any member...
{split 1}

a) React to outside events

b) Email to any member...

10. Prioritize messages from a certain person, especially if the messages are of the same kind (voice mail and voice messages are (or could be) similar).

12. Control the door with any of

- push buttons (sensitive fields)
- keyboard
- mouse
- pen
- touch screen
- voice
- gestures
- radio tags
- bar codes
- motion detector

22. MB, drawings

Message board based on drawings (paint and/or draw)

23. MB, text

Message board based on text (via keyboard and maybe recognition of hand writing)

24. MB, Voice

Message board based on textual and audio presentations.

(see also story 39)

28. Presence and awareness

- via action
- via sensors
- via video

- via audio

29. Blurred audio awareness
- disguised speech

39. MB Combined
Various types of messages/notes simultaneously.
Transformations between the various media formats.

41. (To be merged) A message is created or removed
Even if we use a list of messages could be created, deleted, moved, read, etc by DND techniques.

We could have icons for each member. A message that could be seen by a certain member results in alternatively that the icon of the particular member is highlighted (while the message i highlighted in the list) or that the icon of the member could be attached to reading area while the message is marked.

We could pass messages by drag them to other members icons.

We can place text items anywhere on the desktop and send them by puffing or blurping.

Discussion and Future plans

The next obvious step is to implement the first computerised version of the Door. This version will be based on drawings made by hand and as little as possible of readymade widget and gadgets. We want to restrict the usage of ready entities, such as notes and buttons, in this version since we first want to see what strategies for the communication the families choose. Later on we expect that the development leads in the direction of developing widgets aimed at communication.

PLANS FOR THE UPCOMING VERSION

The version will be a computerised version that essentially will be equivalent to what is planned for the forthcoming prototype InkPad (see section 3.4). The InkPad will just be enhanced with the facility to create message that are kept as notes, that is they are specially encapsulated messages.

We discussed these ideas with families and decided to start prototyping as scaled a version as possible. We do not want to restrict or smother the free flow of original ideas from us or our co-developing families.

PLANS FOR THE FOLLOWING VERSIONS

The usefulness of using a keyboard and other interaction techniques will be investigated. Video input will be spiked. A formative comparison of the scaled down approach and some more fully elaborated versions of the Door will be made.

Further, in later versions we will also consider exploiting other media than drawing such as sensors or radio tags for detecting the presence of a user, voice recognition, voice authentication, text to synthetic voice, and audio notes.

In the effort to develop a useful prototype for both our families and others it is of particular interest to address the means of communication as such. We will consider how to present information, how we could make users aware of changes and the presence of each other. In the discussions we have

also talked about mobile means to interact with the Door. Therefore we will investigate and maybe incorporate PDAs, cellular phones or simply web-based technologies in future versions of this effort. And, of course, the ongoing effort to evolve the infrastructure of the FamilyNet will continue.

3.3 MirrorSpace

MirrorSpace builds on the concept of the videoProbe, based on our collaborations with the families during the workshops, what we learned from designing the videoProbe, and the experiences and the discussions we had when we installed the videoProbes in the homes of the families. MirrorSpace will be explicitly designed to work as a key service of FamilyNet.

From videoProbe to MirrorSpace

Based on our experience in installing the videoProbe in the homes of several families, we decided that it is important to develop applications that augment currently existing objects, such as mirrors, so that the applications integrate seamlessly into the homes. At the same time the family workshops produced a variety of ideas which use every day environments as well as everyday objects. Suggestions from the workshop influenced us to move in the direction of more gestural input devices and body tracking as a tool to interact with other members of the families.

The notion of technology probes, as developed in the project, is meant to capture information about the use of new technology, rather than providing solutions for it. Therefore it is problematic if a probe relies on discrete information rather than an intuitive input, such as a gestural one. For example, during the Paris workshop, one girl said she wanted to blow a ripple of air to her sister. One of the scenarios from the grandparents was based on an alarm that would be triggered by a child passing unauthorised through the kindergarten gates. Most inspiring though was the observation that all family members had an instant understanding of how to physically interact with the probes. In addition to any functionality that a gestural interface offers or restricts, we realised that it certainly injects a performance element into the use of the probes.

Description of MirrorSpace

MirrorSpace is a mirror that is augmented through a live video link. We like the metaphor of the mirror as an everyday object that can placed in transitional "public zones" of the family homes, like the entrance.

We have started to prototype a mirrorSpace the size of an average bathroom mirror, since we are re-using the hardware from the videoProbes. Over the coming few months, we plan to develop a set of person-sized dressing mirrors. MirrorSpace consists of: a Wacom PL-500 LCD touch screen, a Philips ToUCam Pro USB camera, an Ultrasonic module / stamp microcontroller and a video / sender receiver module.

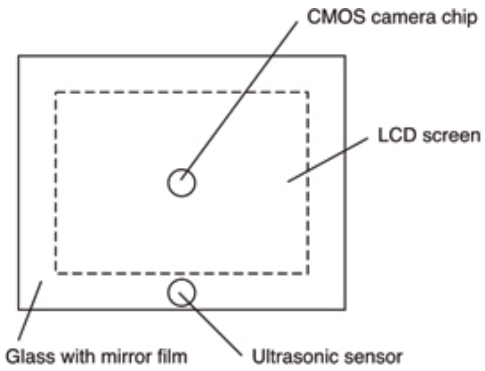


Figure 3.3.1:
MirrorSpace, schematic set up, front view.

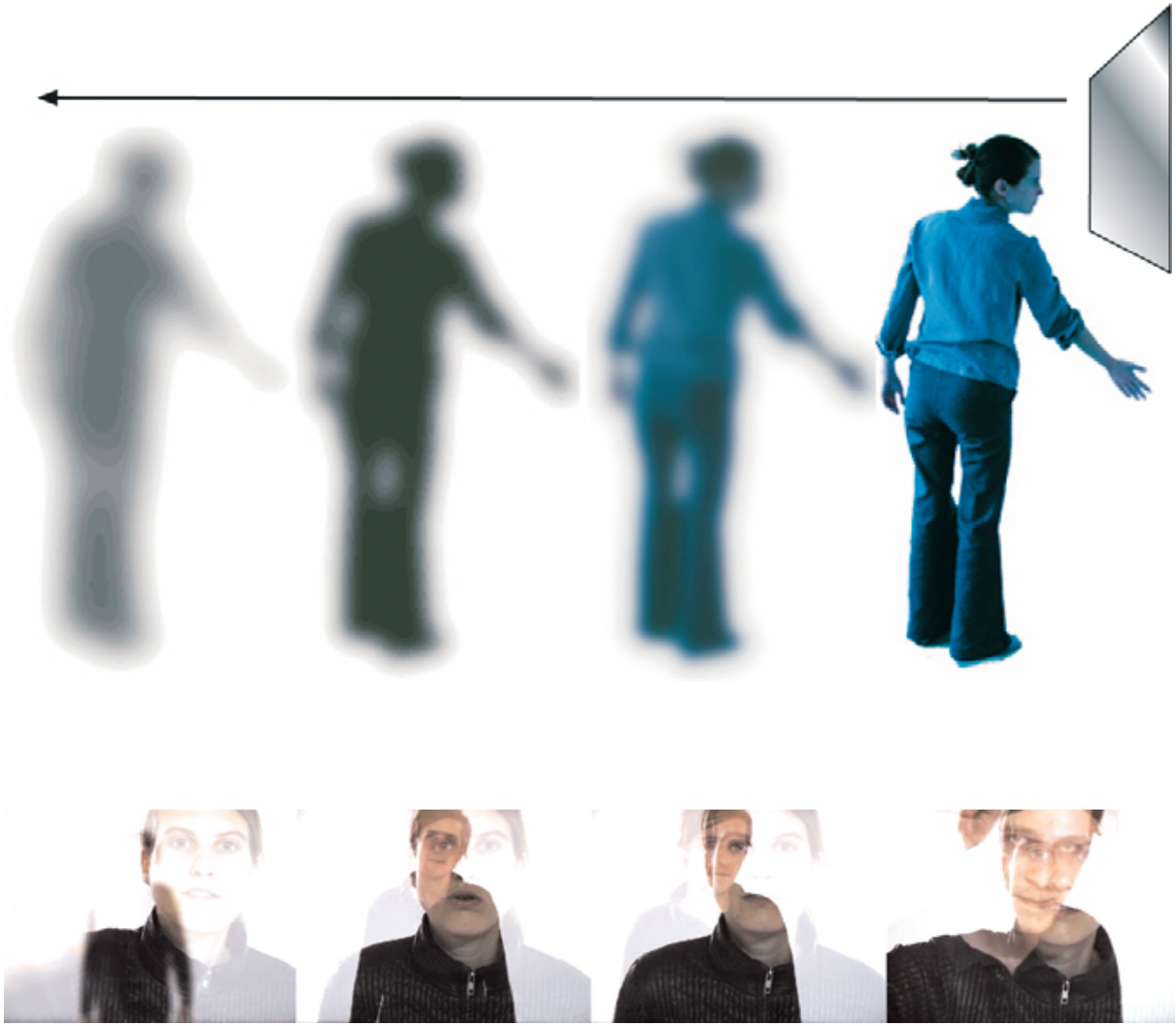


Figure 3.3.2 (top): Image rendering depending on the distance between user and MirrorSpace.

Figure 3.3.3 (bottom): stills from a video scenario to prototype the effect of two places connected with MirrorSpace.

MirrorSpace is designed as a mirror mounted onto a flat LCD display. Incorporated into this set-up is a camera and a ultrasonic sensor (figure 3.3.1). The ultrasonic distance sensor controls the rendered video image in real time. If the user is outside the range of the sensor the mirror acts as a normal mirror. When a user enters the sensitive zone a live video link is established to all the other places in which other users have also entered the sensitive zone. Depending on the distance of the person from the probe, her image will be rendered differently. If the user is far away the image is rendered very blurred and in black and white. Coming closer to the probe results in an increased resolution of the video image (figure 3.3.2). The live stream of all active places is superimposed onto the MirrorSpaces in all the connected locations. The effect of seeing oneself not only on the mirror, but also as a video representation within the virtual mirror space is reassuring. Roussel (2002) describes this effect with the *Digital Well* in which participants look down into a mirrored projection surface which displays themselves and remote participants in one shared environment.

We are convinced that using the approach of a probe goes hand in hand with developing intuitive interfaces that are ideally fully accessible with a simple set of gestural and spatial interactions. Similar to the videoProbe, we plan to use the body movement of users in front of the probe as a tool for interaction. In developing MirrorSpace we would like to extend this theme by incorporating the real physical space in front of the probe.

MirrorSpace is a live video link between two or more places. Since these places are very personal we are building in a filter by using distance. This filter allows for a quick abstract encounter with other participants. These encounters can be made more meaningful by going close to MirrorSpace to have a more intimate exchange. Dunne & Raby (1994) describes this in their work *Fields and Thresholds*: "Space and distance are used to define and negotiate the interface between private and public, particularly during the moments leading up to contact". The design of MirrorSpace also raises privacy issues and connectivity issues, which are addressed with the design of the FamilyNet.

Current state of development

We have developed the individual components of MirrorSpace and must now integrate them into a working prototype. The system is based on a custom-made software application that can share video sources and then blend and superimpose them with each other. We are also integrating an ultrasonic sensor module which sends the distance data to the Macintosh using a standard serial line. Ultrasonic sensors have developed quickly over the past few years and are now cheaper, smaller and more robust. They are also nearly silent, an important consideration for a home application.

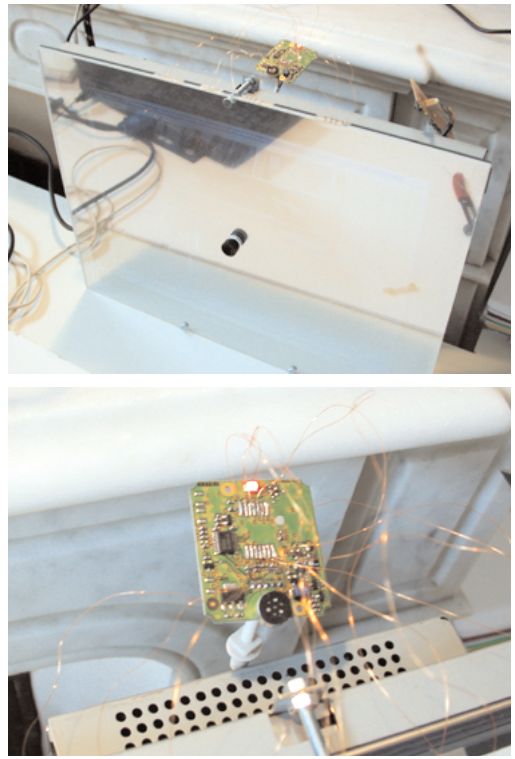
Standard webcam applications, as well as art or research projects face the problem of representation, which is related to the placement of the camera. Since the physical position of the camera is commonly outside the direct field of view of the participants, the displayed video image always looks remote or not engaged. The participants seem to look in another direction. Ishii et al. (1994) have addressed this problem with their *ClearBoard* project. Since MirrorSpace is partly motivated by the idea of creating a very personal device which should allow people to look into each others eyes over a distance, we dedicated part of our research to this problem.

A simple solution is to place the camera in the middle of the screen. We realised that most of the CMOS camera modules, like the one we use for the videoProbe consist of a very small CMOS chip attached to the lenses and a bigger board which handles image correction. We therefore removed the CMOS chip and placed it at the centre of the MirrorSpace prototype (figure 3.3.4). The CMOS chip can be wired back to the rest of the board by using hair thin isolated wire. The CMOS chip itself is small and is not irritating as a physical object on screen.

MirrorSpace and the FamilyNet

MirrorSpace is a kind of media space, with all the problems that that entails. Early media spaces, such as Rave, developed at Rank Xerox EuroPARC (see Mackay, 2000 for a review of this and other media spaces), emphasise the need for providing users with services, not simply connections. Just as in work settings with media spaces, family members need easy ways of understanding and control-

Figure 3.3.4: CMOS camera chip and optics placed in the middle of mirror prototype and connected back to the image correction board using ultra thin wire.



ling who they are connected to, even in situations in which they trust one another. MirrorSpaces, like VideoProbes, are situated in public spaces within private homes, and users will want to be able to interact with people who live in overlapping, but not identical networks. MirrorSpace is a good application for illustrating how the FamilyNet can be used to make explicit the connections among family members, and control who is meeting whom in a virtual mirror space.

Related work

The mirror as an object in conjunction with moving images has been used in many interactive installations and research projects. This seems natural since the mirror itself is a screen. At the same time the mirror is perhaps one of the most primary interactive environments, eg. from Greek mythology, the idea of people looking into puddles and seeing their image for the first time without knowing it is themselves. Fleischmann & Strauss (1998) have picked up on this in their work *Liquid Views*. In LiquidViews the viewer can touch a mirrored video surface which causes the surface of the image to ripple, as if he would touch a real liquid surface. The work *Electronic Mirror* (Moeller, 1993), relates the distance between the viewer and mirror to the clarity of the reflected image, by dimming a liquid crystal film in front of the mirror.

At the same time various commercial applications have been researched and built around the mirror. Philips Homelab research studio has prototyped a mirror for the bathroom that displays information, ranging from health care to stock market figures (Philips, 2002). Very recently Prada developed in collaboration with IDEO and Rem Koolhaas an interactive mirror, which is situated in the changing rooms. The mirror allows people to record and playback little clips of themselves turning in their new clothes.

3.4 InkPad

The InkPad is a tool with, at least in its first version, the main aim to enabling free and non-formal communication among family members of all ages in different households within a family. To support free communication we are trying to make InkPad as relaxed as possible. The focus on this prototype is enabling communication of both important facts and more informal chatting in a way both youngsters, adults, and elder members of the family, computer literate or not, could find meaningful.

Background

Some families started to use the messageProbe as a means to communicate with each other in a way similar to the ways a chat, or a cooperative distributed drawing editor, is used. They used it to communicate happenings, ideas, feelings, playing games such as Tic-Tac-Toe, and for rapid information exchanges. This communication also took place between the generation borders. The communication was to a great extent made by means of drawings.

During the evaluation of the messageProbe we also started to develop the Door (see section 1.5 and 3.2). In the Door effort we started out with an idea of a more formal way of communication. But during the discussions with the Blue family we found that perhaps a tool that was more focused on the "fun to use" aspect than the formalities would be a greater success.

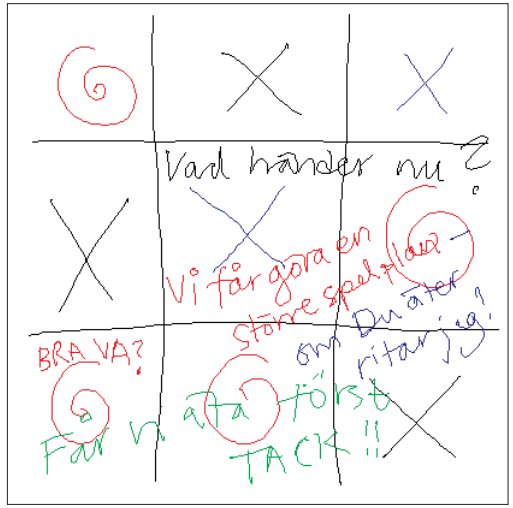
One afternoon, sitting around the coffee table at our research lab at CID, we started to informally assess our meetings with the families. We discussed the way the Blue family used the paper prototypes for "the Door" and the ways they did not. We also discussed relations to the Green family's use of the messageProbe and tools that would be suitable for enhancing their communication. After a while, discussing back and forth, we realized that we probably could develop a tool suitable for both these families. By focusing on a shared space where the users could draw messages to each other, directly or indirectly, we thought that we have something that, at least in its basis, could be developed into something that could be used by both these families. Even though the Blue family required a tool working in the *same place/different time space* aimed at scheduling and the Green family required a tool working in the *same time/different place space* aimed at momentary communication we thought that we had found a doable concept.

So we discussed the core concept of some kind of drawing editor further, both among ourselves and with the families. We saw some deviations between the various requirements but thought that it would be very positive if we could have one com-

Figure 3.4.1
For some people it is natural to draw. And fun, too.

After playing Tic-Tac-Toe somebody writes:
– What happens now?[there is no erase]
– We'll have to make a bigger playing board.
– if you eat I'll draw!
– May we eat first THANKS!!

[The next note was the one in figure 1.4.7.]



mon base for both the Blue family's and the Green family's requirements.

Finally, we decided to continue the Door effort, with its focus on scheduling, but also started developing a new prototype, later named *the InkPad*, focusing on more direct communication and awareness among people situated in different locations. But we also decided to try to unify these two concepts as much as possible.

The birth of the InkPad

After the "coffee table discussions" we decided that we should build some kind of cooperative drawing editor for the Green family, which also could be used as a basis for the Door. The next problem was how to make the application as attractive and useful as possible for all our various family members, from children to grown ups. We conceived that a direct manipulative user interface where the tools, i.e. pens, brushes, saving tools, rotation tools and so forth, should be placed and moved on the canvas, seems to be the best starting approach. In this way we could achieve one of our other goals, i.e. to start with an as scaled down application as possible, since we from the beginning only need just the tools required for the particular situation. If something new is needed we could provide tools for this in some kind of extension toolbox. Where, of course, the toolbox also is yet another tool placed on the canvas.

A SCENARIO

If some user wants to construct, or manipulate, something she just grabs the appropriate tool and starts the construction, or manipulation. For instance if the user wants to create a rectangle she just grabs the rectangle tool, which is situated somewhere on the canvas, moves the tool to the appropriate location and pushes it down there, moves the tool, and the rectangle is created. If the user later on wants to rotate the rectangle she just has to grab the rotation tool, move it to the rectangle and start rotating it by applying the tool on it.

INSPIRATIONS

As inspiration we have looked at for example the classic Sketchpad (Sutherland 1963), with its object oriented and constraint based approach to drawing; A Reality Tool Kit (Smith 1987), built on a physical world metaphor; KidPad (Benford et al 2000), with its approach with toolboxes containing various other tools which could be used to make drawings, notes and other operations on the drawing; but also at Squeak (Kay 2002), with tools for children and visual programming means to define actions.

THE METAPHOR

In order to get as many ideas as possible from the families but still trying to avoid steering too much, we wanted to build something with as many degrees of freedom as possible. Therefore we decided to found the application on a canvas and brushes metaphor, with abilities to change the ink for each brush. Therefore this effort was named the

InkPad. We conceived that the ink could be of various colour and that the size of the tip of the brush should be changeable in size.

CONSTRAINED INK

We also discussed the problem of knowing when a certain message is written and if it still is valid. If one user wants to come in contact with some of her relatives and writes the message “Hello, anybody that wants to chat?” This message is not valid indefinitely and at most until the user that has written it leaves, but perhaps only ten minutes even if the writer of the message stay put. To solve this and similar problems we invented the constrained ink, i.e. an ink that obeys some constraints as it should disappear after ten minutes.

THE CURRENT STATE OF INKPAD

At the moment we have decided to go for the drawing editor concept with moveable toolboxes containing various tools that could manipulate the objects on the canvas, the whole scene or the application as such. InkPad is founded on an extremely direct manipulative concept (Shneiderman 1983). A tool, or toolbox, could be moved around on the canvas. The tools are used to manipulate the canvas or application, i.e. for doing things as drawing, rotating, saving, grouping, etc. A tool stays in the location where it is dropped, so in a way the tool is like any other painted entity on the canvas. A tool, or toolbox, could be cloned and thereby a copy of the tool, or toolbox, is created and placed on the canvas. The attributes of some tools could be controlled, as changing the colour and tip size of a brush.

In the first version we will provide a set of coloured brushes and an eraser already present on the canvas. We will also provide a way to change the ink, tip size, and the aging of the ink of the brushes. Maybe we will provide a means to move a stroke as well. At the moment we are not sure if anything else should be provided in the first release. This must be discussed with the families first.

FUTURE VERSIONS

We start with a very sparse version of the InkPad, with a very limited set of tools. However, we imagine tools aimed at grouping, saving the drawing, audio, smoothing, rotating, zooming, video, handwriting recognition, voice recognition, notes writing, etc. But in a shorter run we believe that we will play with the concept of ink and test other constraints as asymmetric ink, e.g. an ink that is visible at one location but not in another; moving ink; ink responding to general events, as appearing if a certain event occurs and disappear again if another one occurs, is moved to another platform if a third event occurs, and so forth.

DISCUSSION

The metaphor of aging ink seems to be promising and useful in a lot of communication situations. At the same time it provides us with an ability to start in the scaled down, by at first only provide a very sparse and basic set of tools. Combined with the

toolbox concept it also seems to scale very well and it seems almost seamless to add new tools and facilities. By this ability to seamlessly grow the InkPad we also could achieve another important goal, namely the one that not impose too much of our ideas from the start, or build in ways that we assume the application should be used. Instead we could leave this to discussions with the families and studying the ways the application is used.

InkPad and the Door

But could the aging ink approach be used for the Door? Yes we believe so! In the first version we only have means to draw notes by hand by using the brushes, an eraser, aging ink, and maybe a tool to move strokes. By this sparse approach we hope to be able to study how the family organize the notes. We also hope that sparse version of the Door better encourages further discussions and ideas from the families than a more complex one likely does. Later on we conceive Door-specific toolboxes for creating and handling notes of various kinds. Maybe the Door and the InkPad will diverge a bit, but we believe that the core metaphor used in the InkPad also is very promising for the Door. But this has to be investigated and tested further in forthcoming versions before we could draw any conclusions.

Influences from Probes and Other Prototypes

INFLUENCES FROM PROBES

The InkPad has the same relations to the probes as the Door (see section 3.2).

INFLUENCES FROM OTHER PROTOTYPES

The influence from the Door (section 3.2) prototype has already been discussed. There are also obvious influences from all the other prototypes such as
The FamilyNet (section 3.1), with its aim to provide an infrastructure for this kind of effort
The MirrorSpace (section 3.3), with its aim at enhancing both awareness and communication
The Calendar (section 3.5), with its aim to provide for better support for coordination of activities.

Requirements on Infrastructure and Software

The InkPad has the same requirements on the infrastructure as the Door (see section 3.2). We will also use the same software as for the Door prototype.

3.5 Calendar

Motivation

There has been a great deal of research in the area of coordination technology, particularly group calendaring, but it is focused almost exclusively on the workplace . Commercial calendaring software, such as Microsoft Outlook, and hardware, such as PDAs, have been migrated from the workplace to home and personal use with some success. However, this hardware and software is still beyond the price range and/or computer literacy of many family members and frequently requires all family members to use the same hardware or software if they want to share calendar information. Recently, a number of web-based calendaring services have been designed to support families more directly, allowing others to view and post events to shared online calendars and providing the ability to synchronize with other electronic calendars .

The interface design of current web-based calendars for families is still based on the interface design of electronic calendars for the workplace. Users must make "appointments" with fixed starting and ending times, perhaps recurring for a fixed amount of time. While families certainly have these kinds of appointments, they also use their calendars to keep track of many other kinds of information that don't easily fit into this rigid structure. Some events may not have a known or fixed start time, end time, or duration – I need to get my oil changed sometime next week. Some events may be definite while others are only tentative – I may go to the farmer's market Saturday morning. Some events may recur, but for how long is unknown – my child has karate practice on Wednesdays until school is over. Unless web-based calendars can do a better job at handling this "fuzziness" in family calendaring, families are unlikely to adopt them.

We propose to address this problem by defining a model for fuzzy calendar events and then using it to design a web-based application that supports scheduling and visualization of family calendar information. The application will support creating and viewing calendar information for multiple households, families, or individuals and will be bootstrapped by allowing users to import existing calendar data from Microsoft Outlook, utilizing the iCalendar standard as a starting point for managing calendar data. We will iteratively prototype both the model and the application together with our family design partners and then evaluate it in their homes and the homes of other families.

Research

MESSAGE PROBE INFLUENCE

The results of the Message Probe trials in the U.S. directly influenced our research into family calendaring. The families all used the Message Probe with varying degrees of success to write and draw

notes giving status updates, discussing minor news or feelings, and coordinating various things. The three most interesting results across the cultures were the desire to have more synchronous awareness between remote households, the attempts to use the board for coordinating childcare or meetings, and the desire to have more attractive, more fault-tolerant hardware and software in the homes. These three findings, and our discussions with the families following the probe deployment, all lead us to the idea of shared family calendaring.

The first issue confirmed that the CSCW literature advocating the support of remote awareness in workplace groupware applications carries over to family applications as well. Despite the fact that the board was designed to be used both asynchronously and synchronously, users in all the households wrote a number of notes wondering if another party was "there" to chat, and used the board to play synchronous games like tic-tac-toe or connect the dots. Family members from multiple households also expressed desire for some sort of visible or audible notification when a new note was written. We realized that simply providing synchronous capability really wasn't enough for an application that was going to support some level of communication; we needed to support remote awareness much more directly.

This need for awareness carried over to the second issue of trying to coordinate between the different households. A number of households in the U.S. family, tried to use the board to coordinate meetings and pickups for childcare. They found this task difficult because often the requestor wasn't sure of the other party's schedule and if they would even see the note in time. We realized that remote schedule access would be helpful to address this problem. Knowing what other's were doing at the time you needed them to pick up a child might save you the trouble of writing a message, and knowing what they were doing at the time you wanted to write the message would be helpful in deciding if they would even see the message before you needed their help.

What was also necessary to make this task workable was better and more attractive technology. We provided the households with high-speed Internet. However, the technology frequently did not work for various reasons. The Internet service sometimes failed and the message board software sometimes froze or crashed. The families all agreed that the software was fun to play with, but they couldn't rely on it for any kind of important communications – if a child needed to be picked up from school, they would use the phone. When the software crashed, the less technology-savvy households often had to rely on the more savvy relatives to help them, adding an extra burden to these relatives. In another case, a family went away and when they came back, had forgotten how to use the board. This result really drove home the already-reported-on need to make technologies for the home more attractive, easy to use, and fault-tolerant than the ugly, often complicated and crash-prone technology we tolerate at work.

JOINT WORKSHOPS

Following our initial findings with the U.S. family message probe deployment, we held a workshop with all of the U.S. family households in April and a combined workshop with all of the Swedish and French family households in France in May. The moms seemed interested in calendar devices in the home and in devices to keep track of family members who were out. They built prototypes for shared calendars embedded in the refrigerator, paper-scanning calendars embedded in social areas of the house, and GPS-equipped beepers for tracking kids and husbands. The dads were interested in souping up their existing portable devices with new features. They wanted to be able to synch their cell phones with their electronic calendars and to send smells and sights in addition to sounds through them.

Overall then, staying connected with and aware of family and friends was very important, but people had different motivations for doing so and wanted to do it in different ways. Some wanted fixed devices in the home, some wanted to add functionality to existing portable devices, and some wanted totally new and weird devices. Allowing multiple households to view each other's schedules over the Internet provides some of the remote awareness families clearly desire. Later, we could extend this service to improve communication, portability, and tracking by supporting GPS-equipped PDAs, cell phones, and other small devices.

FAMILY INTERVIEWS

Following the workshops, researchers in the U.S. brainstormed about ways to improve existing shared family calendaring applications. The general concept and network support were already available, but the interfaces were either designed for the workplace (e.g. Microsoft Outlook) and thus too complicated for many users, or dumbed-down versions of the same (e.g. Yahoo Calendar). They also were designed for scheduling meetings, not arranging soccer practices, weekend vacations, or grocery shopping. As we thought about these kinds of family events, we realized that many of them were uncertain or fuzzy in many ways. They might happen but exactly when was either unsure or flexible, or they might not happen at all. Thus, we thought that families would want the ability to schedule events for "Friday morning" or "some evening next week," rather than being forced into specifying an exact date, start time, end time, and duration as is required in current calendar applications.

Based on the shared refrigerator calendar prototypes that the U.S. family built during the workshop, we drew up some paper prototypes of shared calendar interfaces with a column for each family as they had described, with the usual buttons for clicking on a time to schedule an event at that time, plus buttons for more general times like morning, afternoon, and evening. We then interviewed each of the U.S. family households in more detail about their current calendar usage and showed them the prototypes to elicit suggestions. In one household, the husband, wife, and two children use the Microsoft

Figure 3.5.1: U.S. paper prototypes.

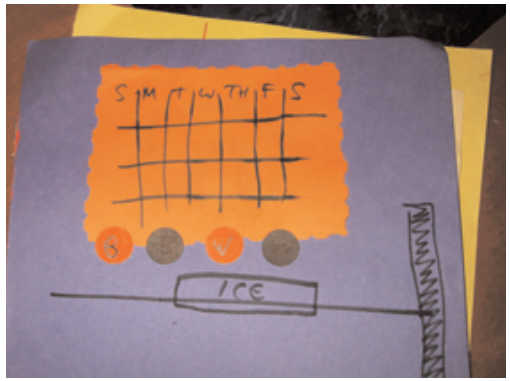
Outlook calendar religiously to keep track of everyone's activities, using the alarm reminder feature to remind them to do things. Practices, recitals, school events, and any other events that arrive in paper format get entered into the calendar. They are pretty happy with the system, but don't have a way of checking or managing the calendar when they are outside of the house. For this household, a shared electronic calendar would thus be an easy transition, but they would also benefit from some portable devices.

In looking at the paper prototypes, they thought it would be nice to be able to put events on someone else's calendar, so long as it was clear whom they were coming from and it did not imply any kind of commitment on the recipient's part. They liked the idea of keeping the grandparents in the loop with what was going on in their house, especially since one of the grandmothers is becoming a bit forgetful. We discussed the different ways you could use the calendar: traditional and fuzzy events, reminders, tasks/to-do lists, and notifications. You can do most of this in Outlook, but not well - tasks are separated from calendar entries, fuzziness is hard to show, and notifiers (e.g. I've gone to the store) are usually just done with Post-It notes. If tasks were integrated into the calendar with fuzzy time (e.g. grocery shopping listed in the morning slot) and would just move along in time and on to the next day if you did not get to them, that would be nice.

We also discussed the issue of input because keyboard and pen devices were hard for the grandparents to use. Voice annotations seemed like a great idea for notifications and sharing requests. If you wanted to put an event on someone else's calendar, you could drag it over to their column and then add a voice annotation that they could play. Or, if you were going out to do errands and wanted others to know where you were, you could just leave a voice annotation at the time you left. The audio quality would have to be quite good though. Interestingly, they have a microwave where you can record voice messages but no one uses it. So, we may investigate if this feature would be useful.

The maternal grandparents in the family have a much simpler, more ad-hoc way of handling calendaring. The grandmother handles most of it – important appointments and events (e.g. doctors appointments) that come in paper format are put on the refrigerator as notes. To keep track of birthdays, she writes them on 3x5 note cards so they don't have to be entered into a calendar every year. A lot of their appointments are regular events (e.g. golf and haircuts) so they don't bother to write them down. However, they know that their children and grandchildren's lives are very busy, so having access to their schedules would be nice. In looking at the prototype, the idea of using voice for some features (e.g. I'm going to the store) came up. They wanted the calendar to flash or beep for reminders and messages. They liked the idea that if their son wanted to have them pick up one of the kids, he could drag that item from his calendar over to their calendar, and it would flash or beep until they saw it. They could accept the responsibility by clicking

Figure 3.5.3: U.S. paper prototypes.



on it, or say no by dragging it back to their son's calendar. Given that they don't make much effort in their current calendaring, a simple, easily accessible interface was important. Writing on the refrigerator was good; typing appointments into a computer was not.

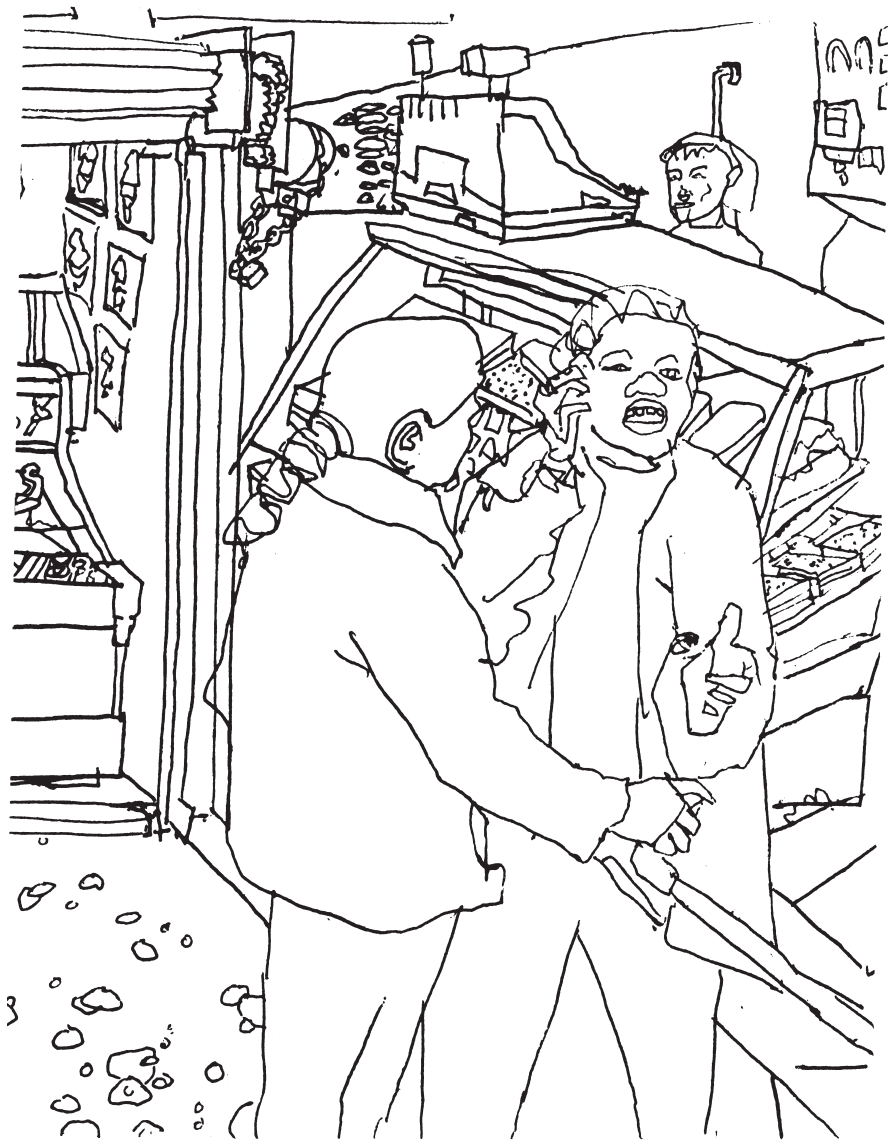
For the paternal grandparents, the roles are reversed. The grandfather meticulously maintains a pocket calendar, writing down all the events in their lives in careful detail. The grandmother also has a wall calendar in the kitchen, but that is used mostly to keep track of important birthdays and anniversaries. Any paper calendars that come in the mail that are important get posted next to this calendar. Keeping track of the past was important for both of them – they refer back to old calendars to remember what they did on the 4th of July 5 years ago, and they continue to record people's birthdays after they have passed away. Like the other grandparents, they have a number of regular events like choir practice that they don't write down because they almost always happen and have happened at the same time for years. However, they agreed that even though they did not need to write it down, it might be useful for the other households in the family to know about it. An electronic calendar that saved events going far into the past would also be quite useful for them, since all their calendar information would then be in one place.

SURVEY

While the paper prototype was helpful in eliciting feedback about how and why existing calendaring events might be shared electronically, and how it might be used for coordination activities, we did not get much feedback in the way of how to create and look at fuzzy events. The more technologically savvy members of the family immediately saw the advantage of clicking on "morning" to add an event rather than having to select 9 or 10 or 11 am, but visualizing exactly how this would work was difficult without a dynamic prototype to interact with. As a result, we have taken three steps to gain more insight into the issue of fuzziness. First, we designed a survey (available at https://www.cs.umd.edu/users/hilary/survey/survey.htm) to gather more information about not only how people currently do their calendaring (what they record, who they share with, etc.) but also how they handle uncertain or fuzzy calendar information. We have sent it to our friends and colleagues with a request for them to forward it on to their friends and colleagues. We are not looking to gather statistically significant results with this survey. Rather, we are looking to broaden our understanding of how people handle their calendars beyond what we have learned from our InterLiving design partners. People's calendaring habits are notoriously idiosyncratic, so generalizations drawn from statistically significant results would not be useful anyway.

FUZZY TIME MODEL AND PROTOTYPE

Second, we have begun work on a model for fuzziness in calendar events, trying to define what dimensions are fuzzy and how they can be mapped into existing notions of time such as "morning", "sometime next week", and "every Tuesday evening". We have only just started this work, as it will constitute much of our research next year. To demonstrate the use of this model, we have begun building a shared calendar application with some early support for fuzzy events. We will iteratively codesign both the model and the prototype with our family design partners, meeting multiple times to allow them to use the prototype in their homes and make suggestions. We expect to elicit a much richer set of design suggestions this way than with our original paper prototypes. This iterative prototyping will also constitute much of our research next year.



4. Research co-operation within DC and at DIS2002

In this chapter we describe experiences and conclusions from three types of research cooperation activities giving input to interLiving in 2002:

An “atelier”, arranged by the Disappearing Computer projects ACCORD, MiME and interLiving on “Disappearing Computing in Domestic Environment”, consisting of two sessions, two days at Xerox Research Centre Europe in Cambridge, England, January 28-29, and two days at KTH in Stockholm, Sweden, March 7-8.

A Disappearing Days workshop, “ Designing Interactive Systems that Disappear”, with participants from the Disappearing Computer projects e-GADGETS, FICOM and interLiving, in London, England, June 25

The “Interactive Thread” during the DIS (Design of Interactive Systems) conference with 300 international participants at British Museum in London, England, June 26-28

These events were very good opportunities to discuss and get greater insight and more material on families and domestic environments and possible IT support for it.

Figure 4.0.1.
Conference antendees interacting with the Interactive Tread at DIS2002 in London.

4.1. Disappearing Days ateliers in Cambridge and Stockholm

This account is an adapted excerpt from detailed reports mainly by Peter Tolmie of XRCE in Cambridge, very good material, gratefully acknowledged.

4.1.1. Cambridge meeting

The First Disappearing Days Workshop for Disappearing Computing in the Domestic Environment was held at Xerox Research Centre Europe's Cambridge Laboratory on 28th and 29th January 2002. The three DC projects represented were MiME, ACCORD, and interLiving.

Attendees were: Tim Diggins, Allan MacLean, James Pycock, and Peter Tolmie from MiME; Andy Crabtree, and Terry Hemmings from ACCORD; and Sinna Lindquist, Wendy Mackay, Yngve Sundblad, and Bosse Westerlund from interLiving.

Prior to the workshop the various projects circulated reading amongst each other so that we might come to the workshop better informed about some of the work each of us had engaged in and the perspectives we had adopted. This pre-reading material is attached to the back of this report as an appendix.

The chief objective underlying the disappearing days workshops on this topic is to bring together a number of researchers in the DC community who have, in the context of their projects, developed a specific interest in studies of domestic environments. We feel that by working in this forum we can properly explore some of the key methodological questions relating to such studies and identify some useful ways to approach such work in future, especially with regard to the evolution of the Disappearing Computer and ubiquitous computing.

ISSUES

These are some of the issues we identified at the outset:

how to conduct studies of domestic environments

the relative advantages and disadvantages of different kinds of methods used:

- new ways forward
- how to articulate study findings
- how to make those findings relevant to design
- the distinction between work and domestic domains
- the particular requirements proposed by domestic environments
- the import of this for future developments in DC and ubiquitous computing

As a specific valuable example we give an account of the discussion about specific problems in studying and developing for families/domestic environments.

WHAT IS THE DIFFERENCE BEWEEEN FAMILIES AND DOMESTIC ENVIRONMENTS?

We explored a number of the practical problems involved in the conduct of studies of families and domestic environments. For instance, we wanted to understand what might be different about doing participatory design with families, and what might be different about doing ethnography in a domestic environment.

One of the things commented upon was that there are at least two kinds of perspectives that might be adopted in participatory design. One of these is squarely practical, but the other is political. For those involved in interLiving there was no desire to change the politics of the families they were working with. They did, however, perceive a need to keep all of the different voices of family members heard in workshops.

With regard to the conduct of ethnography a specific distinction that was voiced was that everyone has a 'home'. There is a sense in which the 'home' is a known environment for the ethnographer and the ethnographer can bring to the setting some pre-existing competences that they do not have to learn from scratch. It is not like going into a production print environment where a great deal of what is going on might have to be learnt 'as of new'. This offers specific advantages with regard to the prospects of doing rapid studies though the downside might be that it takes more work to make what is going on 'anthropologically strange'.

In relation to finding a focus we have already noted that there is an apparent problem with cutting up domestic environments in the same kinds of ways as work domains. Something we commented upon here is that the division of labour in domestic environments is far more fragmented. In particular we noted that the organisational categories of a workplace render it more amenable to ethnographic study than the organisational categories of the home. For a start, activities that take place in work settings have a certain boundedness that adheres to the categories of work that subsume them, whereas domestic categories such as wife, father, daughter, grandma are hugely open-ended. It is also the case that the organisation of some activity is explicitly and organisationally accountable in the workplace. This is not really the case in a home.

Within the contemporary work environment, particularly the corporate office, it is an expected and explicit exercise (and often time or meetings are set aside for this) for workers to reflect on their personal and departmental working practices and to suggest "process improvements". While it would be wrong to say that in a domestic environment people are always or necessarily unreflective, at the same time there is clearly a distinction with work – in the home, reflection on practice is rarely an explicit, articulated or even desirable activity. InterLiving found that there were marked differences in readiness to reflect/introspect between their Swedish and French families. However this comes about, it is an indicator that this reflectivity is likely to vary across families.

At an even more practical level, one of the most striking aspects of studying domestic environments

through situated observation is the dynamic character of the environment. The pace, dispersion and rapidity of change for activities is notably greater than in work environments. The gamut of emotional expression is also much wider than in the workplace. This has ramifications regarding the basic realisation of observation giving rise to such questions as 'what or who do I follow?', and 'how do I keep out of the way whilst they are doing it?'.

KEY LESSONS LEARNT FROM THE WORKSHOP

GENERAL

'Domestic environments' throw up some unique challenges for study, not least because the term glosses an extensive and heterogeneous set of domains, and this has important ramifications for both the focus and the breadth of studies undertaken, with 'more' not always equating to 'better'.

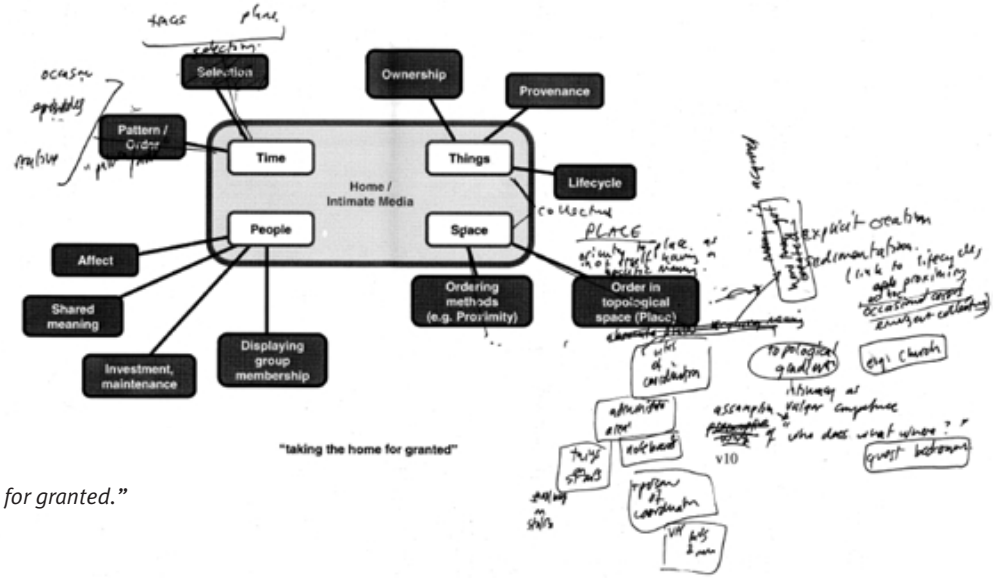


Figure 4.1.1:

"Taking the home for granted."

The organisational categories of a workplace render it more amenable to ethnographic study than the organisational categories of the home, but the fact that domestic environments are already 'known' to us means there is less of an overhead in acquiring special competences to study them.

It is not necessarily harder to study domestic environments than work environments but distinct accounts have to be provided by those studying them and this has important ramifications with regard to the practical realisation of studies and ethical protocols.

Domestic environments are highly dynamic and this poses distinct problems for the gathering of data.

The assumption of a linear progression from studies to analysis to design fails to capture participatory design approaches and is of limited relevance even to ethnography.

SPECIFIC FOR THE SECOND WORKSHOP:

The above points indicate that there are some unique requirements relevant to studying and designing for domestic environments, but what is the particular import of these for the Disappearing Computer?

The possible relationship between ethnography and participatory design, and design practice more generally remains to be effectively articulated but what lessons can we learn from our own approaches, especially with regard to design in terms of the Disappearing Computer?

Should technology disappear more in the home or the work environment?

Where is the appearing computer in the domestic environment?

OPPORTUNITIES FOR COLLABORATION BETWEEN THE PROJECTS

GENERAL

The innovative nature of Disappearing Computer technologies and their new domains of application mean that the need for true **multi-method empirical research** has never been stronger. Could we apply all the methods being deployed within MIME, interLiving and Accord to a common site?

interLiving uses **design and technology as resources** in the generation of data about family life but the role of design and technology for the practice of ethnography has been little considered. Could design communicate ethnographic materials? Can DC technology change the possibilities for ethnographic study and analysis? Can design benefit from an ethnography of design workshops?

The study of the home and of families highlights the fact that **communication is a critical topic** for Disappearing Computing technologies. Messaging and telephoning are already ubiquitous but how do we move beyond them towards different forms and purposes of communication (e.g. to include concepts such as ambient presence)?

The domestic environment demonstrates the need for people to be able to **'make technology at home'** but the ability to customise and fold technology into daily lives extends beyond the home. How do people appropriate and adapt pervasive computing?

SPECIFIC

It was clear to the participants from interLiving that they might find a rich source of additional data in the ACCORD and MiME projects so there was definite scope for sharing resources. In particular interest was expressed in the material gathered by ACCORD with regard to activities around the kitchen table.

Similarly members of ACCORD and MiME were interested in how interLiving had actually used the data they had gathered and in finding out more about the notion of 'technology probes'

There were several suggestions about possible future partnerships beyond the projects we were currently engaged in. In particular we were interested in investigating what a relationship between ethnography and participatory design might look like.

Specific proposals were that it might be possible to do an ethnographic study of something like the design work in interLiving, and that there might be scope for a design input into improving ethnographic materials, especially with regard to the ways in which they are represented.

A further suggestion was that we might together take something like 'communication' as a topic of mutual interest. It was thought this could contain a number of features, e.g.:

- A methodology swap as an atelier – using our methodologies on each other
- Looking at ways in which people play with new technology and work out how to use it

- The rebirth of the nuclear family through communication between families – filling the gap
- Looking at communities of practice and how they evolve and work
- Looking at generational differences and different orientations to technology

One additional suggestion was that we might work together on papers, e.g.: a paper on the study of domestic environments; a paper on the questions raised during the workshop about the constituents of 'design' and 'innovation'.

4.1.2. Stockholm meeting

The Second Disappearing Days Workshop for Disappearing Computing in the Domestic Environment was held at Kungl. Tekniska Högskolan, Stockholm on 7th and 8th March 2002. The three DC projects represented were MiME, ACCORD, and interLiving.

Attendees were: Tim Diggins, and Peter Tolmie from MiME; and Stéphane Conversy, Björn Eiderbäck, Sinna Lindquist, Wendy Mackay, Yngve Sundblad, Helena Tobiasson, and Bosse Westerlund from interLiving.

KEY ACTIVITIES AND POINTS DISCUSSED:

Much of the first part of the workshop was devoted to a video-prototyping exercise devised to explore one another's particular relevances and ways in which we might work more effectively together.

Out of this two basic video prototypes were created, both grounded originally in real-world observation.

Various topics were discussed including:

- the feasibility of modelling a process for this kind of work;
- the interaction between ethnography and design and how ethnography should best 'feed in' to design;
- how ethnography might change in order to fit into a design process and the ways in which designers and ethnographers might go about locating a mutually effective way of articulating their interests, including video-prototyping;
- the character of design problems and the importance of distinguishing between these and research questions;
- the relative importance of adopting an open-ended orientation to research in this kind of endeavour;
- how the design might begin to take shape once the design problems have been established and the role of technology probes within this;

DESIGN WALKTHROUGH AND REFLECTION ON PROCESS

During the morning of the second day of the workshop we took an opportunity for each group to play back their design scenarios and talk them through. Normal practice is again more extended at this phase of the process with the aim being to walk through the scenarios slowly and gather critiques and suggestions from the whole group, including

the storyboards. Time again did not permit for a full reflection upon the process within the confines of the workshop but once again the main aim of the exercise here was to explore possible ways of collaboration rather than to produce refined video prototypes.

One aspect of the exercise that did prompt some discussion, however, was the importance of acquiring basic video production skills for the effective realisation of such prototypes. This seemed to extend beyond aesthetics and ramify upon the effective articulation of important features of the design idea.

DISCUSSION

PROCESS

One of topics of discussion was whether there are clear steps in a process within this kind of work, with an obvious sequence such that one thing needs to be done before another, then another, and so on. It wasn't immediately clear that there was such a process and the designers in the group articulated a common concern they have with when the right moment might be to actually begin to design, with them perhaps holding off in the first instance, thinking there is little they can do without the data to ground their activities. It was also suggested that, even could some process be written out and pointed to, it would be hard to orient to that as a solid model.

There is a great deal of potential complexity in the engagement between various interests. Input is commonly sought from a number of different competences such as ethnographers, industrial designers, and system designers. It was clear that a good deal of work still needs to be done in this area with many of those present expressing some concern about their current lack of confidence in present practice leading to an effective design process.

THE INTERACTION OF ETHNOGRAPHY & DESIGN

In the course of discussion about process the issue was raised of how ethnography might interact with design and, in particular, where ethnography and other kinds of input might be said to feed in. Just as it is hard to be prescriptive about process in general, so it is hard to suggest there is just one way this should happen, or only certain places where the ethnography is relevant. Indeed, the long-term policy of co-location of ethnographers and designers at XRCE has shown the value of not being overly-prescriptive on this score. Opportunities for ad hoc interaction between ethnographers often enable work to proceed more quickly and effectively.

However, there are also clearly important junctures on the life-cycle of any project where there is a particular need for ethnographers and designers to engage with one another. Various ways of accomplishing this might be envisaged but we discussed in particular what the video prototyping exercise engaged in earlier in the workshop might have to offer in this respect. Everyone at the workshop saw a definite advantage to the use of video prototyping activities in at least two respects: team-building and consensus building. Through such activities designers and ethnographers learn how to work together and about one another's interests and

Figure 4.1.2:
Tim Diggins doing a quick video brainstorming of an idea for a interface on the inside of the front door. Here he checks out a task from the to do list with his (augmented) mobile phone.

concerns more effectively. It is also an opportunity for them to come to some common understanding of what 'the problems' that they are attempting to address might be. However, video prototyping cannot work on its own and is certainly where the interaction should end. It provides ethnographers with a chance to toss in some initial understandings and observations through the use of scenarios, but there are further stages where analysis of materials will need to feed in. It is also possible for ethnographers to elaborate more broadly upon social logics at other stages in the development of a design.

HOW DOES ETHNOGRAPHY CHANGE TO FIT INTO THIS DESIGN PROCESS?

The important point, it would seem, is that *the* ethnographer(s) and *the* designer(s) on some design team should be able to find a relation between their two activities and find a way of articulating that for their practical use in *these particular circumstances*. In these terms it would seem that video-prototyping offers one particular space for such an articulation of fieldwork and other findings in ways that are relevant to design, rather like the grounded innovation map developed at XRCE as part of MiME (See MiME Deliverable 6), which was discussed at the previous workshop. Here ethnography is being purposed to a quite specific end and, to some extent at least, is being shaped towards those ends. The topic always has some impact upon the conduct of ethnography. As we mentioned in the first workshop what an ethnographer captures in a house will be hugely different if he is there on the one hand to observe family life, and on the other to observe home-working. Similarly, where a part of the ethnographic output is going to be scenarios to ground video-prototyping some of how one captures particular instances will be influenced (for instance by marking out in one's notebook instances that will be good as a basis for such scenarios, perhaps where order most visibly breaks down). More importantly, how one comes to represent those instances will become nuanced to the requirements of where the stories of those happenings will be told. There is, at root, a range of possible solutions to how you gat 'data' and make it talk to 'creative work'.

One of the perceived advantages of allowing ethnography to play such a role was that it could be used in such a way very early on in a project's lifecycle and might in that way allow designers to get under way with design work straight away. In this early design work designers would be afforded the opportunity to discover what they need which could then be further provided by other resources such as ethnography.

WHAT ARE 'DESIGN PROBLEMS'?

One of the topics that provoked the most discussion was the character of 'design problems'. It was felt that there is an important distinction between research questions and design problems. A research question alone is not necessarily enough to do design. The fundamental issue amounts to 'what to design'? It was felt there was also a need here to perhaps distinguish between things like innovation and invention and design. Participatory design, for instance, might be seen as co-operative

Figure 4.1.3:
Yngve and Sinna find their missing socks and umbrella in the vacuum cleaner. (augmented and shared?) (from the video brainstorming).

innovation. It was pointed out that no-one is just told to 'go design something'. Designers typically work with some kind of a brief. That can have ramifications because in research projects where there are, to start with, only research questions rather than design problems, designers may often wait until they have discovered 'the brief' as it grows out of efforts to address the question. It was also noted that there is an effort to put the brakes on designers – to stop them from starting to design too soon – perhaps because of worrying about not being able to go back or throw designs away. However, some of the designers present saw a definite need for things that can be thrown away in order to articulate what is kept – that in a sense, designers do their thinking through designing, and stopping them from designing could be like stopping them from thinking. Thus "designing" can be a research process rather than a research product. In InterLiving a great deal of effort was devoted to get the families to create their calendars. However, these were developed to be discarded. They were seen as a way to move forward but not '*the* design'.

In a similar vein it was seen as important to distinguish between 'ideas' and 'designs'. Much effort has been devoted by InterLiving to accessing what seems important to the families and cultivating the presentation of their ideas. These, however, are seen to constitute data, not the design as such and not necessarily even the brief.

A further issue of some moment that arose in this area was how much researchers engaged in this kind of exercise should be designing for future threads or towards a single output. An analogy was drawn here with commercial product development versus open source. There are, of course, closures and versions in open source and there is, equally, open-endedness in product development. However, in essence it was felt that there was some importance in understanding whether the ultimate orientation is towards something closed and complete at project end or something that could open out into and inform a whole new research agenda.

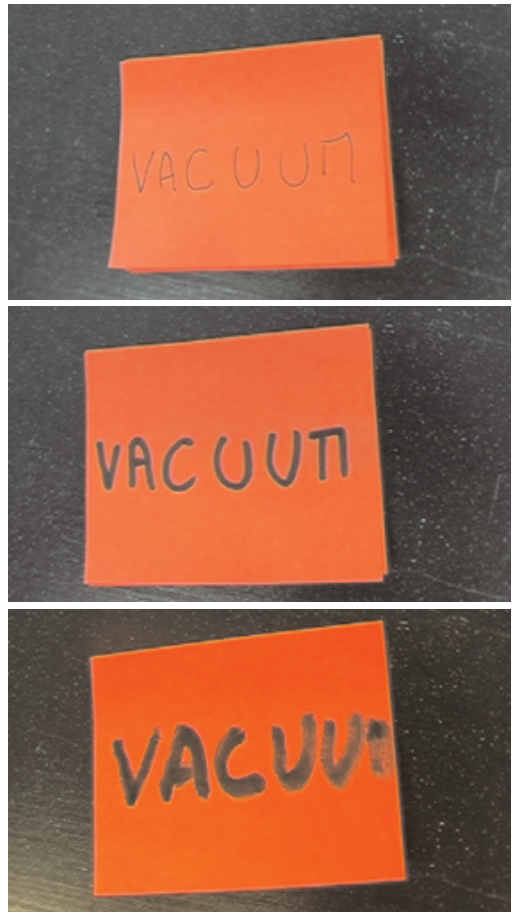
This has important implications. For research in areas such as the DC design is often conducted for the purposes of thinking. It is not a funnel model and designers would resist being imprisoned within something overly specific that becomes development rather than design. However, one needs to set against this the overall funnel of research. There are, for instance, necessary parameters proposed by applications for funding.

HOW DOES THE DESIGN THEN TAKE SHAPE?

Once the character of the design problem and orientation is established how does a design actually take shape? Again it seemed important to make a number of distinctions here. In particular it seemed necessary to distinguish between interactions and functions. Furthermore one can point to interaction with the system, interaction with the environment, and interaction with the user.

In the context of this discussion InterLiving elaborated a little upon the idea of 'technology probes'. These are intended to inspire design rather than be *the* design. Typical characteristics are simplicity, minimal functionality, being open-ended from the

Figure 4.1.4:
Notes with text that gets bolder and bolder the nearer the event it gets. There was also an idea where the text fades away when the message become obsolete. (from the video brainstorming)



use point of view (like a Post-it-Note). The aim is to watch how people use these probes. The interest is in their *use* rather than their functionality. Ideally they should reflect back data and, as such, might be best understood as a data gathering device where the goal is to get them to think about how a technology might be. They might even be used to quite deliberately break or breach interaction in order to reveal important aspects of it.

Another matter of central concern is getting the balance between the designer and the client right in their negotiations about what the design should look like. Some way has to be found to articulate the input of all of the parties within the ultimate design.

IMPLICATIONS FOR THE DISAPPEARING COMPUTER

In the course of the above discussion a number of issues of direct relevance to the Disappearing Computer Initiative were touched upon. Perhaps the most central of these related to the problem of what to design and the need for a design brief. It was felt that this issue had been somewhat elided in the DC's original call by making 'what to design' the research problem by effectively saying: 'there's a lot of ubiquitous computing and disappearing computing out there, what are we going to do with it?'. In that case one might argue that the first round of DC projects have really been needed to begin to lay the foundations regarding what the design problems might be, but there is a concomitant requirement for continuity if potential solutions to those design problems are to be properly explored.

Focusing quite specifically on the interest of the three projects represented in domestic environments it was felt that the workplace offers something to solve in ways in which the domestic does not. Innovation in the workplace moves beyond problem-solving. There are significant differences in concerns over productivity. This impacts on where to begin but not at all where to end and therefore needs solving for the home as well and therefore proposes a real challenge as to how to articulate 'requirements' for the design of domestic technologies.

A few more immediate possibilities, especially with regard to cross-project collaborations, were considered. One idea suggested was that it might be worth establishing cross-project workshops where individuals with a similar expertise working on different projects might be brought together to work with one another for a short intense period in order to develop a DC relevant perspective within their own disciplines.

Other, more specific ideas were:

- the involvement of XRCE/ACCORD ethnographers in Interliving workshops in order to try and arrive at a sense of the underlying logics and assumptions made available in the scenarios and design ideas proposed by the families
- an additional workshop in the Autumn to feed into continuing DC projects

4.2. Disappearing Day workshop in London

This workshop "Designing Interactive Systems that Disappear" was arranged by Wendy Mackay of interLiving and attended by participants in the Disappearing Computer projects e-Gadgets FICOM and interLiving:
Irene Mavromatti (e-Gadgets, CTI, Patras, Greece), Achilles Kameas (e-Gadgets, CTI, Patras, Greece), Astrid Ullsperger (FICOM, TU Cottbus, Germany), Frank.Clemens (FICOM, EMPA, Switzerland), Wendy Mackay, Stéphane Conversy, Heiko Hansen, Helen Evans, Helena Tobiasson, Kristina Lindkvist, Bo Westerlund, Yngve Sundblad (all interLiving in Paris and Stockholm).

We were interested in collaborating with other members of the Disappearing Computer initiative to discuss the unique user interface challenges associated with designing interactive software that "disappears". Although the field of HCI has offered a great deal of advice about both methods and techniques for designing standard keyboard/monitor/mouse systems, we still know very little about how to design for these new technologies. We were particularly interested in the following questions:

- what are the unique design issues associated with disappearing computing systems? If the technology or the interface is invisible, how do users control it? how do users understand how it works? how do users successfully understand and handle breakdowns?
- what kinds of design methods are most effective?
- what solutions have been found
- how can we make these findings relevant to designers in other DC projects?

We decided to take advantage of a biannual multidisciplinary gathering of researchers and designers who are interested in the process of designing interactive systems and held a Disappearing Days workshop just prior to the DIS'02 (Designing Interactive Systems) held in London, on June 26-28, 2002. Our goal was to work with members of projects who address the unique user interface design issues associated with computers that disappear.

We organised the meeting so that each participant would have an opportunity to discuss the specific user interface design issues they face in their respective projects, including any problems they have encountered and any solutions they may have created. We felt that this would be an effective way to share our respective expertise and learn from each other, by exchanging ideas and discussing more and less effective design solutions.

We also actively engaged participants in a design exercise, and produced video prototypes of new designs at the end of the day. We assigned the

participants to small working groups, spreading project members across groups. Each group began with a scenario-building exercise, in which they shared anecdotes about real-world events that were relevant to their particular projects, sometimes as part of a formal data collection process, sometimes as informal observations and discussions with users. The next step was to create a shared scenario that reflected the events captured in the anecdotes and provided a contextualised basis for designing new technology.

Once the participants had completed their 'use scenarios', they engaged in a brainstorming exercise, to develop ideas for disappearing technology that would be relevant to their scenarios. Each group was then give a video camera and supplies for making mock-ups of their ideas. Each group created a 'video prototype' that illustrated how their new technology would fit within the scenario they had created. At the end of the workshop, we showed the videos and discussed the issues that they raised with respect to the design of disappearing computing systems. The participants were all given copies of a DVD tutorial on video prototyping techniques (Mackay, 2002), which provided more detailed examples of how to try these same exercises in within their own projects.

Although the workshop just touched on a few solutions, participants were pleased with the opportunity to discuss these issues and to actively explore concrete design ideas. They liked the notion of exploring the design space and several have written back to say that they particularly enjoyed learning to use the design techniques we offered.

4.3. Interactive thread at the DIS2002 conference in London

4.3.1. Methodology Innovations: The interactive thread

We have argued that our basic strategy, i.e. working with a small number of families over a long period of time, is fundamental to this project and our efforts to understand how to create new effective technologies for the home. However this approach has a cost: we have little to say about families in general. While we believe that creating technologies that make sense for these particular families is likely to be more generally useful, nothing in our basic methodology guarantees this. (In fact, as we have said elsewhere, our families are self-selected as being relatively "happy", highly-communication-oriented families, which has biased the types of interface we are creating for them.)

Since an important goal of this project was to explore design methods for creating new technologies for families, we have tried a variety of different techniques in our work with the seven families, as described elsewhere in this document. We use the concept of triangulation, using multiple methods derived from different disciplines that are founded on different assumptions and value systems. This provides a far richer set of information for us to work with and forces us to challenge our pre-conceived notions.

However, most of that work has concentrated on our core set of families. We also decided that it

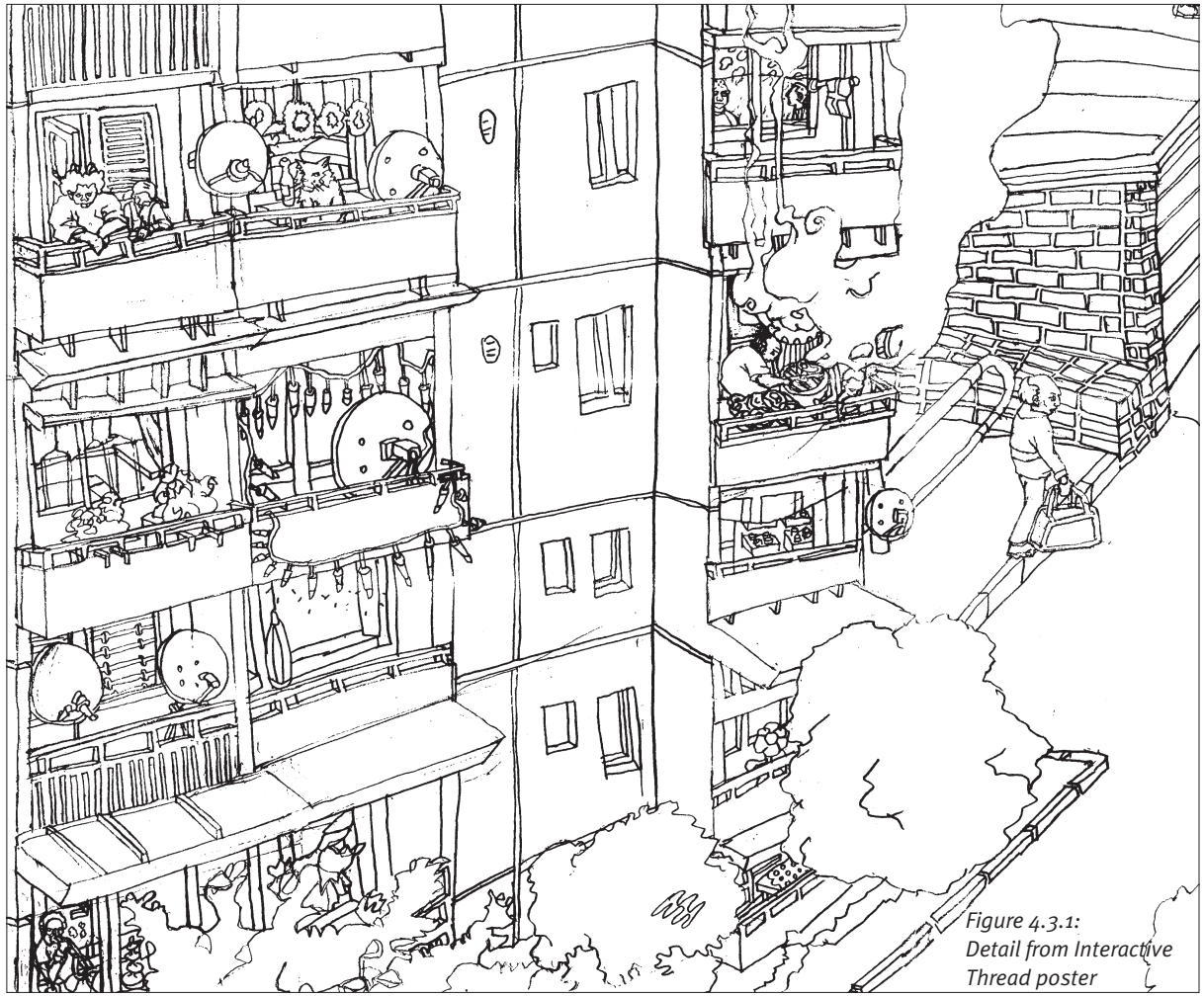


Figure 4.3.1: Detail from Interactive Thread poster

figure 4.3.2: Poster on the wall. (video images)

Figure 4.3.3: Closeup

would be beneficial to reach to a wider group of people and find out about their issues when dealing with families and their ideas for new technologies. The standard strategy in this situation would be to create a survey or questionnaire, with quantitative, i.e. easily-summarized, questions, and give it to a large number of people. However, such questionnaires are also biased, strongly influenced by the questions asked and the context in which the participants answer. We also find the results of such questionnaires to be of little use when it comes to design.

So, we decided to experiment with a different approach, taking advantage of the conference DIS2002 (Designing Interactive Systems), held in London this past June.

Over three hundred people showed up, with backgrounds roughly evenly divided between HCI professionals and design professionals. Since all of them presumably have families, and are interested in HCI and design issues, it seemed the perfect opportunity to try something different.

We created the "Interactive Thread", which involved a multi-disciplinary series of design exercises that ran throughout the conference. In the context of the conference, our goals were to facilitate interaction among conference attendees, teach new design techniques that cross disciplinary boundaries (HCI <–> Design), and to provide a forum for discussing design issues. From the perspective of the InterLiving project, the Interactive Thread provided a wonderful opportunity to obtain a large amount of detail-rich data and design ideas from an audience with particular expertise in this area. It also provided the foundation for a "Participatory Design Toolkit", which we can now use both as a teaching device and as a simple, easily-accessible method for distributing these diverse design techniques to our Disappearing Computer colleagues. (We have iterated the design of the cards that were used at the DIS2002 conference to make them more suitable for general use and will hand these out at the Jamboree.)

4.3.1. Interactive Thread design

The conference organizers generously allowed us time in the program (five minutes at the end of each session, plus a longer introduction in the beginning and conclusion at the end), as well as space (approximately three meters of wall space in the main corridor, next to the technical exhibits). We discussed many different options for how best to use the time and space and settled on the following:

We commissioned a large poster that was based on our studies of the Swedish and French families, as reported in deliverable 1.1. Henrik Färlin, the illustrator who created the drawings for this deliverable, reviewed the scenarios and then created a large illustration that represented (generalisation with detail) the wide variety of situations that the families told us about. The resolution of the image is very high and the poster, with many people of all ages in many physical settings engaged in a variety

of activities (figure 4.3.1 shows a detail from the poster).

We placed the poster on the wall just outside the entrance to the main auditorium, where it would be easily seen by all conference participants. By itself, the poster is amusing and fun to read. But it also served as an impressive conversation piece, encouraging colleagues and strangers to talk to each other and compare family experiences.

We used the poster as the backdrop to a set of twelve exercises, roughly divided into three main categories: 'finding out about users', 'generating new ideas' and 'selecting and implementing a design'. We selected techniques that we know and have either used or developed ourselves. They represent a variety of disciplines, from various social sciences and design. When juxtaposed, it is easy to see how the compare and contrast and sparks discussion about the benefits and disadvantages of different techniques.

Helen Evans and Heiko Hansen created the visual design, including an "interactive thread" dynamic logo (captured in different static forms on each card). Wendy Mackay, together with a number of contributors with both HCI and design backgrounds, worked out the basic format and wrote the final text. The original DIS version was a standard A6 format, either a stand-alone card or folded in four sections to create an A6 footprint. The revised version, influenced by our experiences with the first version, is wider, a custom-made size that provides more space for the exercise and is visually more

Figure 4.3.4a: (top): Critical Incident technique: front (scaled 70%)

Figure 4.3.4b: (bottom): Critical Incident technique: back (scaled 70%)(see the appendix for all)

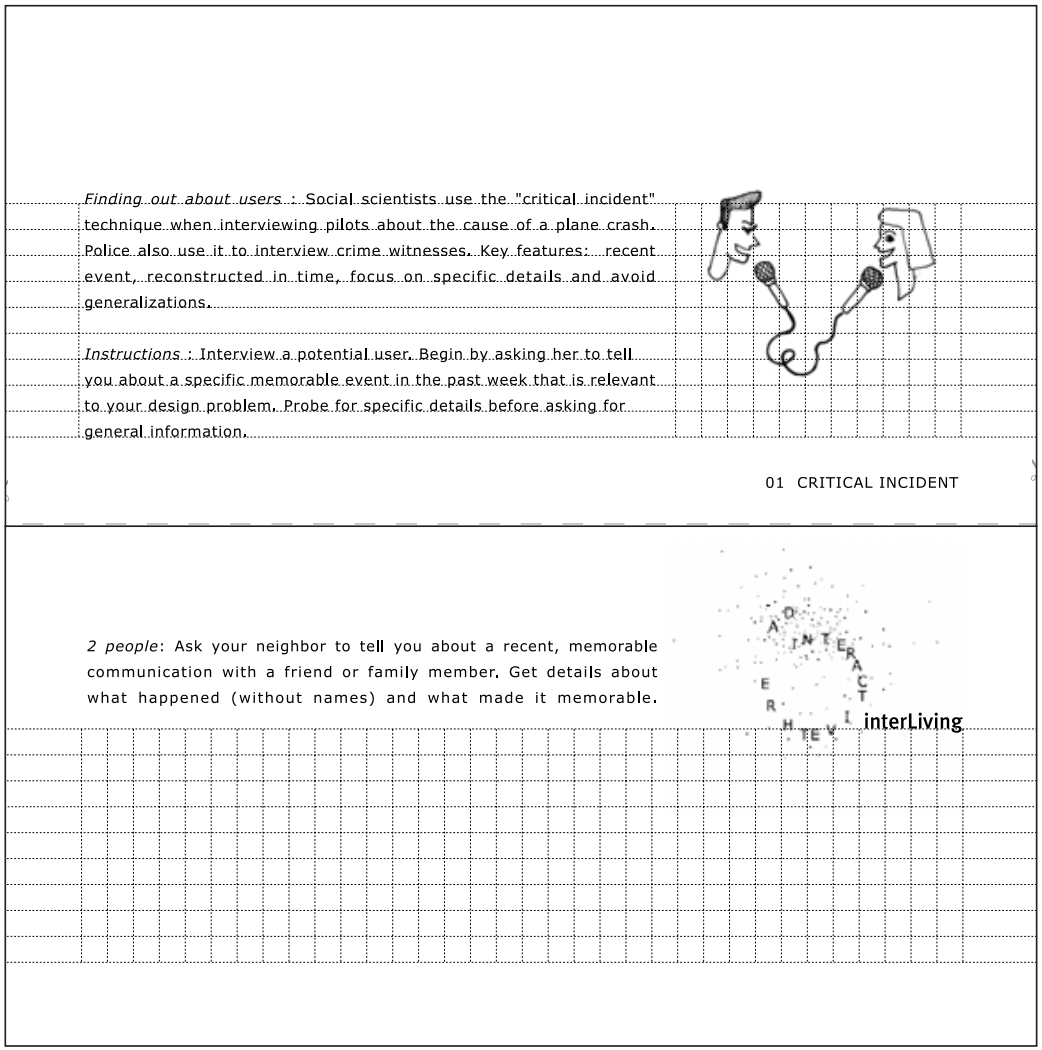
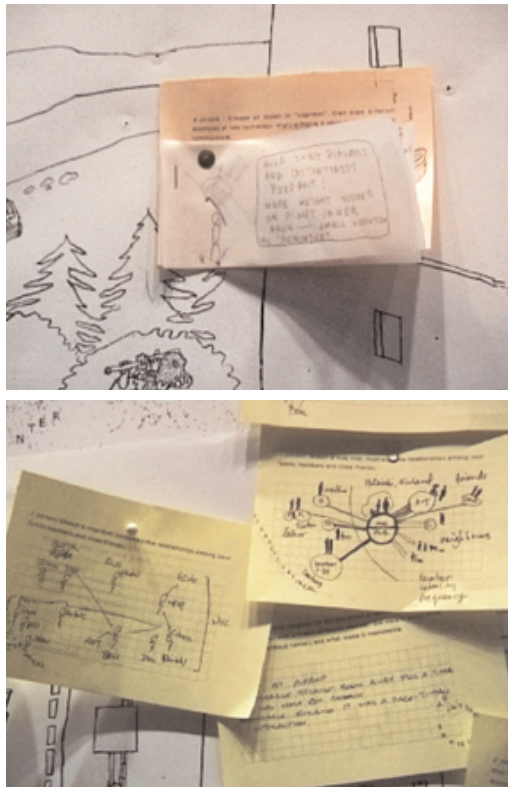


Figure 4.3.4 & 4.3.5: Close-ups.



elegant. The cards all fit together in an open binder with the following description:

INTERACTIVE THREAD is multi-disciplinary collection of participatory design methods that span the design process, from finding out about users, to generating new ideas, to selecting and implementing a design.

InterLiving initially presented the Interactive Thread as an experiment at DIS2002, to gather data and ideas for innovative family technologies. Each card describes a specific technique and general instructions, with a design exercise and workspace on the back.

Our GOAL is to share these methods in a format useful to other Disappearing Computer Initiative projects. The cards can be used individually or in sequence and can be learned quickly and adopted by diverse design teams.

Each card contains one exercise, designed to be completed by one to four people in five-ten minutes. The front of each card gives the name of the design technique, a tiny bit of background including the discipline it is derived from, and general instructions for how to use it. The back of each card is the "creative side", with a design exercise specifically tailored to the interLiving project and space for users to write or draw.

For example, the first exercise helped to 'break the ice', by asking audience members to interview each other, using ""critical incident technique" from Human Factors.

We prepared twelve exercises for DIS2002, although we omitted two due to session time overruns. (All twelve are included in the revised package.) Wendy Mackay introduced each exercise and explained what to do. InterLiving members and student volunteers helped with the logistics of handing out cards and other materials, answering questions, and generally observing what happened. At the end of each session, participants were asked to go outside to the main poster and pin their work to a relevant scenario. So, for example, if the participant had just interviewed someone about an incident on the beach, she would find that setting and attach the anecdote there.

4.3.2. Interactive Thread at DIS2002: results and discussion

The general reaction to the Interactive Thread was very positive: people liked its interactive nature and the breadth of design activities and many said it was their favourite part of the conference. However, we would probably change things if we did it again.

First, it was exhausting for the organisers, who were required to participate in every single session, and also for the participants, who were generally tired at the end of a session. Also, people like to choose which sessions to attend and were frustrated when the only reason to go to a session was the interactive thread at the end. Even so, we had about 80 people who persevered throughout the confer-

The exercises were:

1. Critical incident technique (human factors): Each participant interviews another audience member about a particular memorable communication event in the past week with a member of their family.

2. Relationship Map (design): After viewing a short demonstration of Bill Verplank's "how to draw starmen" (available on the DVD that accompanies this deliverable) each participant was asked to draw a map of the current relationships between himself and other family members, using geographical, emotional, technical or other organising principles.

3. Cultural Probe (design): Pairs of participants were given disposable instant cameras and asked to take a photograph of an object that they were wearing that reminded them of someone in their family. They were then to attach it to the card and explain.

4. Questionnaire (sociology): Groups of four participants were asked to collaborate on a questionnaire with four quantitative questions related to problems in family communication.

5. Use Scenario (HCI): Groups of four participants were asked to share anecdotes about recent breakdowns in communication among family members and then to create a synthesis of these stories, illustrated in a storyboard. The card for this exercise was accordion-folded into four sections, each representing an event in the story.

6. Brainstorming (Psychology): Groups of participants were asked to brainstorm and write a list ideas for new technologies to support communication among family members.

7. Augmented Object (design): Groups of participants were asked to choose and draw an existing physical object, and then draw different ways to augment it to enhance communication among family members, with one idea for each of the attached sheets of tracing paper. (People could either build on each other's work or create separate augmentations.)

8. Constraints (design): Groups of participants were asked to pick a single sensory medium (such as a still image, a noise, pressure) and a single communication function and then illustrate or write about a situation in which it addressed a breakdown of communication among family members.

9. Design Scenario (HCI): Groups of participants were asked to build upon an existing use scenario and revise it with an idea for a new technology derived from one or more of the previous idea-generation exercises.

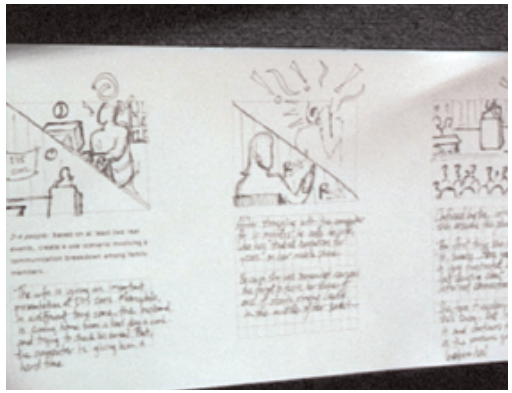
10. Ballot (Psychology): Individuals were asked to vote on their favorite design idea. (This was informally added to the end of the brainstorming session, which is where it belongs in a regular session.)

11. Walkthrough (Software Engineering): Groups of participants were asked to take different roles and systematically walkthrough a design scenario, offering ideas and suggestions for improvement. (We converted this into a sort of live "video prototyping session", in which two audience members were asked to act out their design scenario in front of the audience.)

12. Branding (Marketing): Groups of participants were asked to consider the audience, message and logo for the new design. (We ran out of time for this session and ended with the previous one.)

Figure 4.3.6:
A storyboard stuck to drawing in a relevant place.

Figure 4.3.7:
Closeup of storyboard.



ence and participated in most if not all of the sessions.

The first day was a clear success: Most of the audience participated throughout the day and many people gathered around the poster outside, which was quickly covered with cards. Participants were fresh, interested in the novelty of the activities, and perhaps most importantly, were able to complete the exercises in the allotted time. We gathered a huge amount of information relevant to the interLiving project (which we are still analysing), with a diverse collection of stories and some common themes. Participants had no trouble finding (or interpreting as relevant) scenarios in the poster illustration and enjoyed making a direct connection with their experiences.

We made a major error the beginning of the second day: we took down most of the cards (which by this time had completely obscured the poster). We left what we thought was a representative set, but also cleared room for the second days' exercises. Unfortunately, this reduced the level of interest in the poster. Before, people milled around reading anecdotes and chatting with the people around them. After, people were less inclined to stand around the poster and reduced the level of interest. The second problem with the second day was that some of the exercises were simply too long for the allotted time. An interview or brainstorming a few ideas is easy to do in ten minutes; creating a scenario and storyboarding it is another matter. Participants continued to give us back the results of their work for the short exercises, but were reticent to give us the longer storyboards. Another problem is that people started skipping sessions altogether on the second day. (It was held in London after all!)

Although we retained a core of about 80 committed participants (some of who arrived only for the interactive thread), general attendance went down. Some people mentioned that it became harder and harder to sit through a full session and then do the interactive thread afterwards: they were simply too tired. Also, some people were frustrated by the fact that the interactive thread was held at the end of every session and felt that they could not participate if they had skipped a previous session. (This was not strictly true, but the sessions toward the end clearly did build upon each other more than the earlier ones.) A final criticism was heard from some of the professional designers, who were quite happy to provide us with information about how they communicate with their families, but less enthusiastic about offering their own design ideas. (One said: "I do this for a living; I don't need to give you my ideas here!") Interestingly, from the perspective of InterLiving, the stories about family life were far more useful than the ideas we received.

The third day was the most difficult to implement as design exercises, since it required working with the results of exercises from the previous two days. We received a small number of design scenarios (five), which made it difficult to continue with the other planned exercises. We modified the final exercise, using a design scenario from two audience members and asking them to act out the scenario and the design solution, while being video

taped. Although we showed the basic idea, this exercise would have worked better if we had even five minutes to prepare. The exercises on the last day, and both the scenario/storyboard activities, take significantly longer than the time we had available. So we were able to convey the idea of what one could do in such a situation, but only a few people were able to complete the exercises. (Those who did took the exercises to lunch and returned them afterwards.) Even so, we feel it was important to include the latter exercises to show how to follow through a complete design cycle.)

Although we have no plans to repeat the interactive thread, we have learned some valuable lessons. First, we were able to obtain a large quantity of rich, detailed data from an interesting group of potential users in a very short period of time. We also learned from the comments we received from participants, and have clarified the exercises in the revised version, which is now available for teaching purposes and as a source of methodology ideas to our Disappearing Computer colleagues. If a group adopts this set of methods, choosing the ones that seem appropriate at the time, they should allocate more time to each exercise. In a class setting, the full set of exercises can be executed in two days, or, if motivated, in a single, very intense day.

The interactive thread met its goal of exposing people to diverse methods and different ways of thinking about the design issues, but clearly has not (and could not) make the participants experts in any single technique. We plan to write up a more detailed report of the results and submit it for publication in the next few months.

5. Future work -Prototypes and Families

In this chapter we give some ideas and outlines for activities for the rest of the interLiving project time, until December 2003.

Our work with the families and our experiences designing and implementing the technology probes has caused us to re-evaluate our earlier plan to create a single prototype as the final deliverable for this project. In the beginning, we did not have a clear idea of any particular problem that needed solving; families, particularly those in our study, use a variety of communication means to keep in touch with each other. After a year and a half of work, we feel we have identified a real, previously not addressed need that requires a shift in assumptions by network suppliers and application designers.

Our work shows that families would like to be able to create and manage small-scale, protected communication networks among different households, with family members and close friends. Once they have this capability, we (and others) can create a diverse set of communication technologies, from simple 'appliances' to complex applications. However, until we have this underlying infrastructure and an effective user interface to manage it, most of the prototypes described in the literature will be too complex to be adopted by families.

So, we will try to create the two types of prototypes described in chapter 3 in the remaining half of the interLiving project.

The first, the FamilyNet, will let family members, including small children and nontechnical adults, establish and reconfigure small-scale, secure networks among overlapping sets of family members and close friends. We are experimenting with a tangible interface that makes the interaction clear and easy to use. (We can use this type of interface because these networks are explicitly designed _not_ to scale.) We are also working with public key cryptography to establish a spam-free, closed network, that uses existing phone and internet lines in a different way.

The second type of prototype is specifically derived from our experiences with the families, in workshops and with the technology probes. We have identified both practical and more whimsical applications, each of which requires something like the FamilyNet in order to be successfully adopted by families. They are all, in some sense, a shared surface.

The fuzzy shared Calendar addresses the needs to get a joint overview of families' activities.

The Door prototype is a shared surface designed to be placed on the back of an entry door. It meets a similar need in a different way, allowing family members to exchange diverse types of messages

about their whereabouts, thus improving the communication through sharing information of scheduled activities, in a more individual way.

The MirrorSpace prototype is an answer to a common request for individual family members to have innovative ways of staying aware of and communicating with other specific individuals in other households.

The Inkpad, which is a distributed shared surface that you draw on, is meant for playing, informal chatting and background awareness but can also be used for important messages.

Together, these prototypes provide a glimpse of how distributed families of the future might be able to effectively communicate with each other. If we are successful, families will have a simple and effective way of establishing a network of family members and close friends, and of mixing and matching different communication appliances that meet their changing communication needs and desires.

The development of the prototypes will continue to involve the families as described in chapter 1 in participatory design, with extensive use and evaluation sessions, mainly in the families' homes.

A criterion of success, difficult to reach, is when the families want to use at least one of these prototypes regularly and sustainably as a resource in their daily life, also after the project.

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2 people: Ask your neighbor to tell you about a recent, memorable communication with a friend or family member. Get details about what happened (without names) and what made it memorable.

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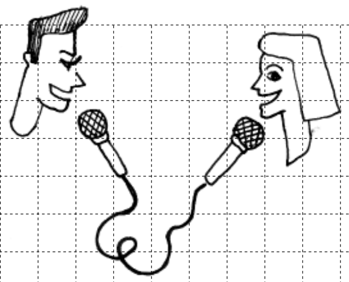
Finding out about users : Social scientists use the "critical incident" technique when interviewing pilots about the cause of a plane crash. Police also use it to interview crime witnesses. Key features: recent event, reconstructed in time, focus on specific details and avoid generalizations.

Instructions : Interview a potential user. Begin by asking her to tell you about a specific memorable event in the past week that is relevant to your design problem. Probe for specific details before asking for general information.



01 CRITICAL INCIDENT

1 person: Sketch a map that illustrates the relationships among your family members and close friends.

interLiving INTERACTIVE THREAD

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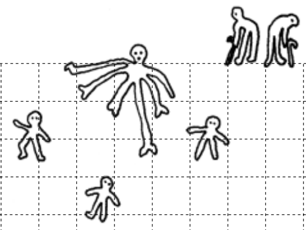

Finding out about users : Designers use a variety of sketching techniques to illustrate and communicate ideas, using simple symbols to represent concepts and dynamic events as well as objects.

Instructions : Ask a potential user to draw the current relationships between himself and other people in the form of a map, using whatever organizing scheme makes most sense: geographical, emotional, technical, genealogical, etc.

02 RELATIONSHIP MAP

INTERACTIVE THREAD unit 02
http://interliving.kth.se/publications/thread/index.html

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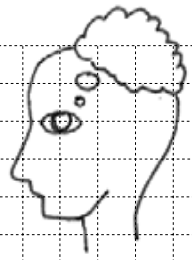
Finding out about users : Designers use cultural probes not only to discover more about users, but also to inspire and engage users in a design discussion. Probes should be open-ended to give both participants and designers a chance to think creatively.

Instructions : Provide a potential user with a disposable instant camera and ask her to take photographs of objects that are relevant to your design problem. Ask her to annotate the photo, explaining why the object is important.



2 people : Take a close-up flash photo of an object (worn or carried) that reminds you of someone you care about. Attach it to this card and explain why.

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4 people : Decide the focus of your questionnaire. Each person should then contribute a quantitative question, either to find out how people use today's communication technologies or how they feel about them.

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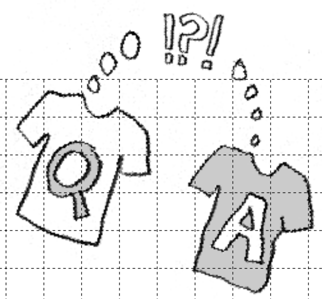
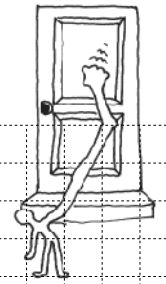


Finding out about users : Sociologists use questionnaires to obtain data from large numbers of people. Quantitative question types include: multiple choice, yes/no, rank (1 low, 5 high), categories and scales (strongly agree, agree, no opinion, disagree, strongly disagree).

Instructions : Create a questionnaire with four to eight quantitative questions relevant to your design problem. Be sure that these questions relate to your potential users' current experiences and address different issues.

2-4 people : Based on at least two real events, create a use scenario involving a communication breakdown among family members.



Finding out about users : Social scientists use scenarios to describe realistic situations based on real events. As a simple form of user data analysis, they preserve detail and context while generalizing across situations. Storyboards illustrate these scenarios and provide the foundation for subsequent design.

Instructions : Create a scenario that combines aspects of actual experiences by potential users, derived from interviews and other data. The scenario should involve one or more fictional characters, a real setting, and specific, realistic events. Illustrate the scenario in the form of a storyboard, with a sketch and an explanation for each event.

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05 USE SCENARIO

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4 people : Generate as many ideas as you can about innovative communication technologies for families.

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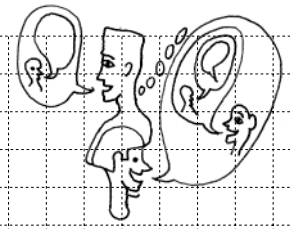
Generating new ideas : Psychologists developed brainstorming to facilitate creativity. The emphasis is on quantity not quality of ideas. Brainstorming sessions work best with a specific topic, limited time (one hour maximum), a scribe to record every idea and a moderator to ensure that all participate and that ideas are not criticized.



Instructions : Choose a theme relevant to your project and generate as many ideas as you can in 30-60 minutes. Record all ideas and do not discuss them, except to clarify what you meant.

4 people : Choose an object to "augment", then draw different examples of how technology might enhance it to help people to communicate.

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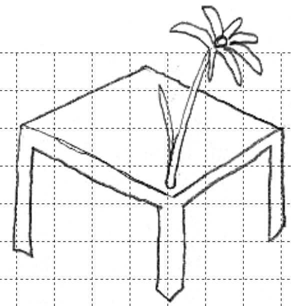
Generating new ideas : Psychologists and designers use techniques such as the "exquisite corpse" to force people to build on each other's ideas. The goal is to create new associations and inspire new design directions.

Instructions : Choose an existing physical object that is relevant to your design problem. Draw the object and then draw a variety of different ways to augment it, using the layers of tracing paper.



07 AUGMENTED OBJECT

2-3 people : Design a communication device that uses one medium (image, writing, touch) and has one basic function. Illustrate it with a sketch showing it in use.

interLiving

INTERACTIVE THREAD

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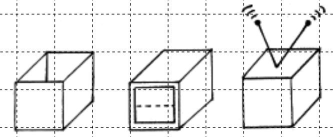
Generating new ideas : Designers have discovered that some of their most creative design solutions appear when the design brief is highly constrained. New design directions can be explored by dictating extreme limits to functionality and experimenting with unusual solutions.

Instructions : Pick a single sensory medium (such as a still image, a noise, pressure) and a single communication function. Illustrate or write about a situation in which a potential user could use a device with these characteristics to address your design problem.



INTERACTIVE THREAD unit 08
http://interliving.kth.se/publications/thread/index.html

interLiving

INTERACTIVE THREAD

2-4 people : Revise one of the use scenarios to show how a new technology will help family members deal with a specific type of communication breakdown.

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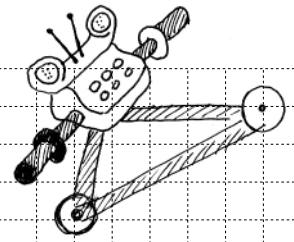
Selecting and implementing a design: Designers use scenarios to envision how new product ideas will be used in realistic situations. They preserve detail and context while generalizing across situations. Storyboards illustrate these scenarios and provide a way to communicate design ideas to people from different disciplines.



Instructions : Choose a use scenario and an idea for a new technology. Revise the scenario, thinking about what happens when a user of the new technology faces the same situation. Consider both positive and negative aspects.

09 DESIGN STORYBOARD

INTERACTIVE THREAD unit 10
http://interliving.kth.se/publications/thread/index.html

1 person : Vote for your favorite design idea.

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interLiving INTERACTIVE THREAD

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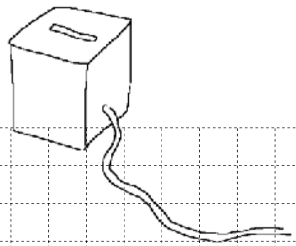
Selecting and implementing a design : After a group brainstorming session, it is helpful to know whether the group agrees on particular design directions.

Instructions : After a brainstorming session, re-read all the ideas out loud. Each person should vote for their top five ideas. Note which ideas have multiple votes and whether or not the group has a consensus.



10 BALLOT

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4-6 people : Present your storyboard or video to a group of experts eg. design, software, marketing, social sciences, and list the issues and challenges found at each step.

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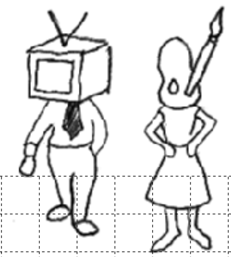

Selecting and implementing a design : Even early in the design process, it is important to get feedback from experts from other fields. A design walkthrough provides focused advice and identifies potential design problems.

Instructions : Assemble a diverse group of experts. First present the complete storyboard or video, then walk through it step-by-step asking for comments.

2-3 people: Define the brand values for your design idea.

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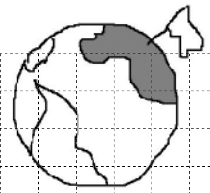
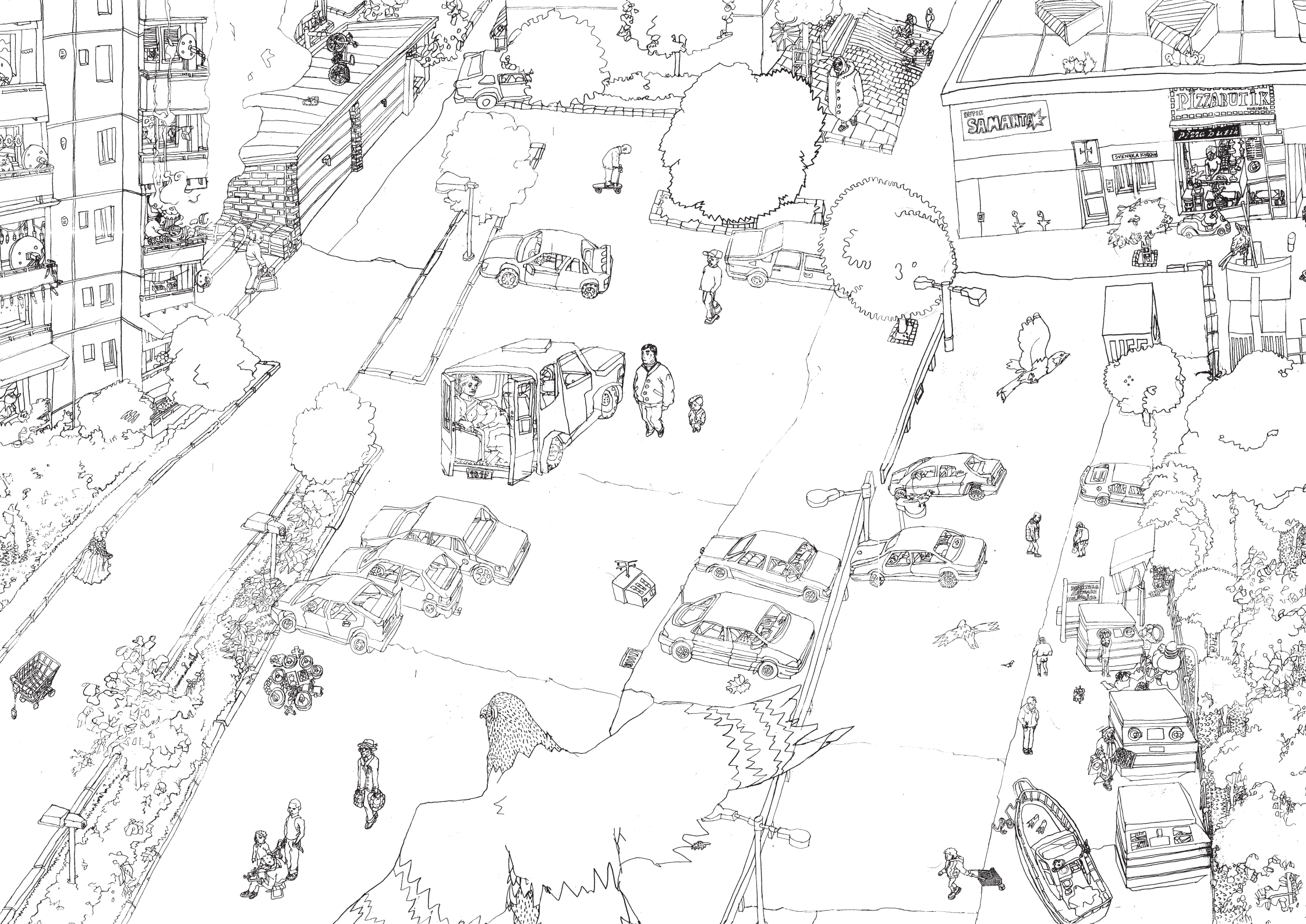


Selecting and implementing a design : Marketing involves creating a brand identity for a new product. The brand values are embodied in every aspect of the design, from the product itself, where it is sold, to the design of its logo.

Instructions : Create a market for your design idea by developing a set of "brand values" that express the identity, beliefs and culture that underly your future product or service.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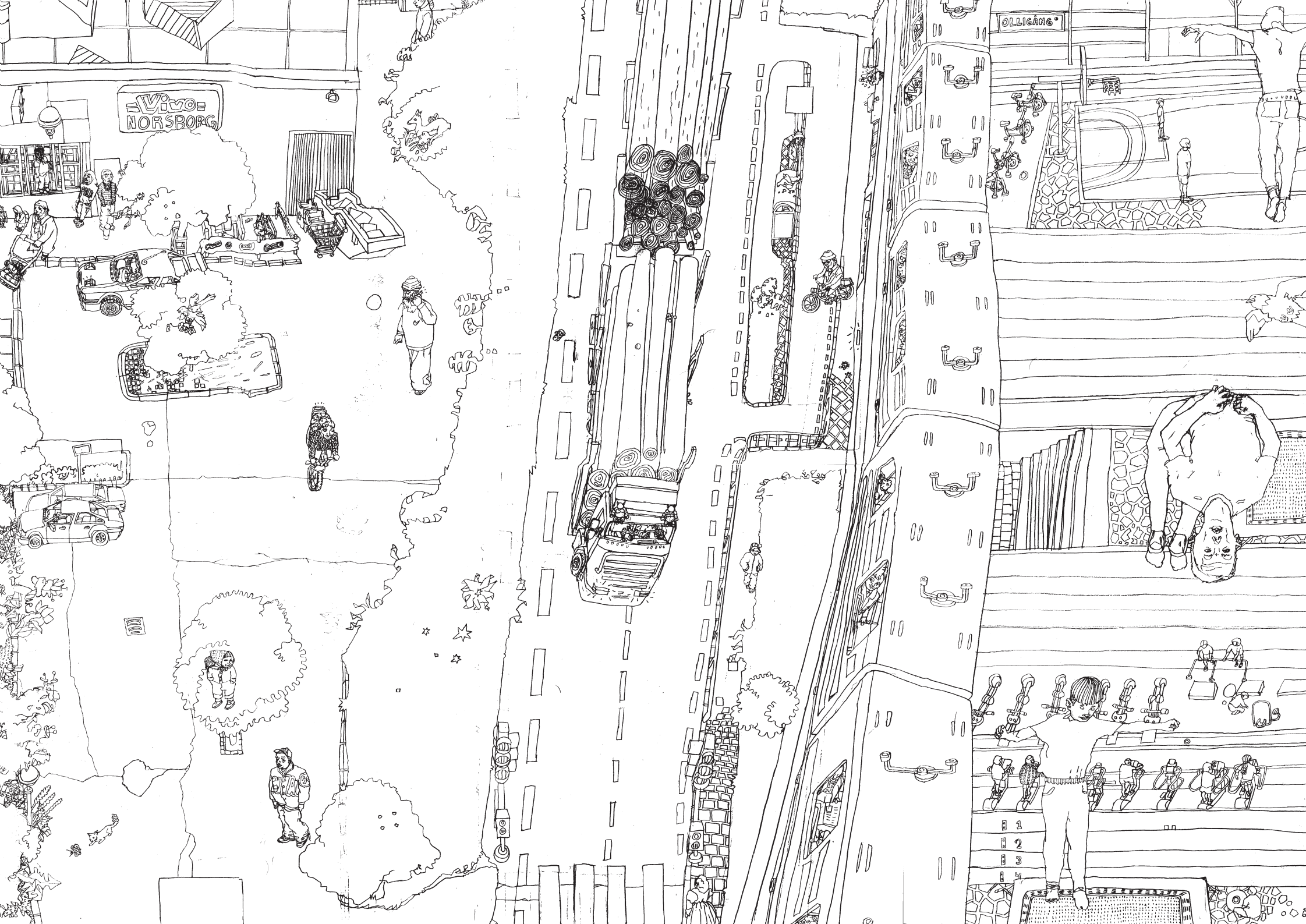
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