

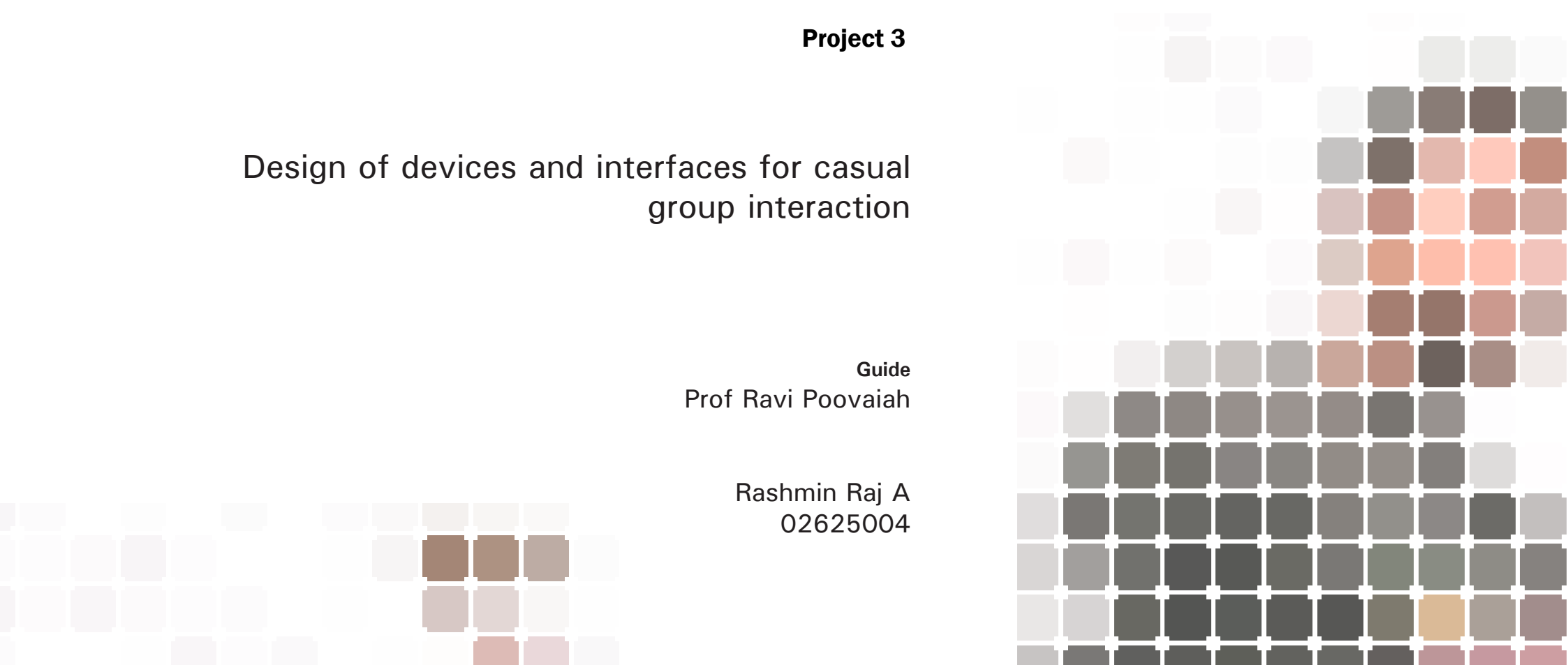
**Project 3**

Design of devices and interfaces for casual  
group interaction

**Guide**

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## Approval sheet

The project entitled "Design of devices and interfaces for casual group interaction" by **Rashmin Raj A.** is approved in partial fulfillment for the Masters Degree in Visual Communication course at Industrial Design Centre, Indian Institute of Technology, Bombay.

Signature of Guide:.....

Signature of Chairperson:.....

Signature of Internal Examiner:.....

Signature of External Examiner :.....

## **Acknowledgement**

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## Contents

Introduction	5
Problem definition	7
Communication aspects	9
Casual interaction	13
The aspects of casual interaction	14
Pointers for casual interaction	16
Group interaction	18
Experiments	20
User study	24
Media analysis	28
Design Ideas	30
Final Concept	43
Detailed design	47
Visualization	60
Bibliography	71

## **Introduction**

Communication is one of the most fundamental needs. The new century has brought about a revolution in the way we communicate. The coming of wireless devices and the wired world has changed our lives and made devices ubiquitous, but at the same time brought forth new problems and issues. One of the most important developments in the area of interpersonal communication is the telephone. The telephone which was a public device, developed to become a very personal device with the coming of the cell phones.

The path of this development wasn't smooth, the video phone was predicted to become the next generation communication device but somehow failed miserably in its task. The development of new technology and services need to take lessons from the mistakes committed in the past.

The development in communication devices were mostly concentrated in the areas of one to one communication, these include devices like telephone, mobile, sms, email, chat. In the area of one to many devices, there is email, chat and other mass communication devices. The devices which come in the area of many to many communication devices include the conference phone and tele or video-conferencing

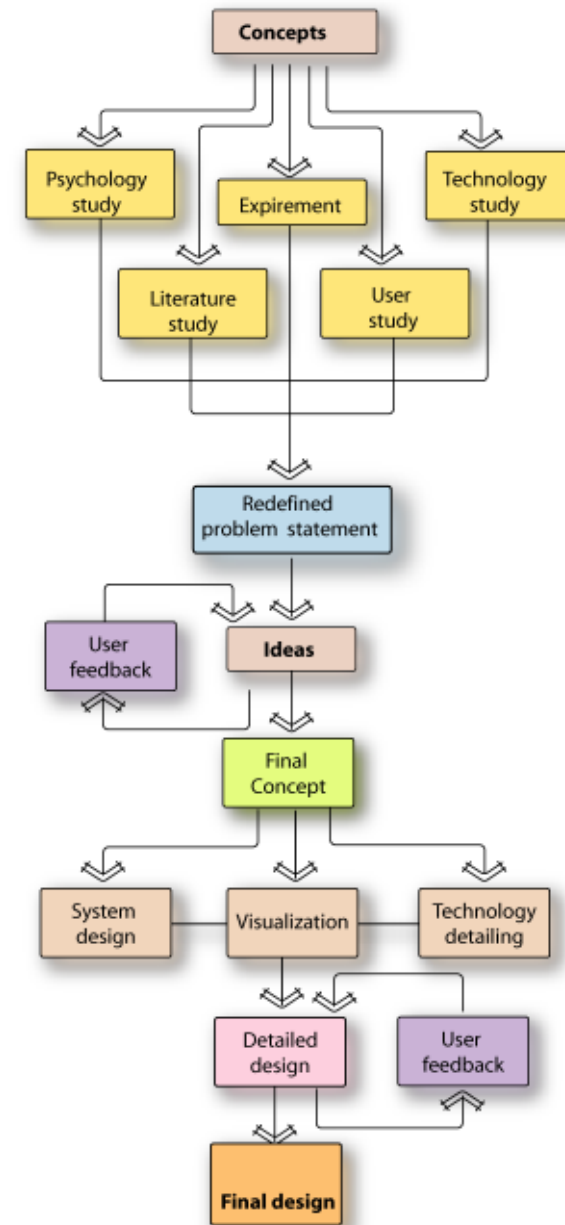
Humans are social creatures and one of the most important activities they engage in is group interaction. It's a bit strange that most of the communication systems available don't support casual group interaction. The current technologies mostly support formal group interaction. Thus there is a need to develop devices which support informal group interaction. I feel that the next big development in the area of communication would be in the area of ubiquitous group interaction devices.

**Problem definition**

The aim of the project is to design devices and interfaces to support casual group interaction.

**Vision:**

Can we relive the moments of fun and laughter we shared as friends in college. Interact as a group once more with friends who now are so far far away.



*Methodology followed*



### Communication aspects

Communication can be defined as the art of transferring, transmitting or exchanging thoughts or information. Communication has been a fundamental human need and has served as a means to connect people. Communication could be divided into verbal or non-verbal communication.

**Verbal communication:** Human vocalization includes highly evolved array of language, sounds, symbols, music, cries and laughter

**Non verbal communication:** This includes all communication which relies on gestures, signals, symbols, icons, gestures and proxemics. Non verbal communication supplements or replaces verbal communication.

Communication could be further divided into mass com-

munication and interpersonal communication. The key theories of interpersonal communication are **social penetration, communicator style, uncertainty reduction** and **expectancy violations**.

The theories which are relevant to the project are

Social penetration theory (Gerald Miller)

Relationships become more intimate over time when disclosure takes place. The theory tries to forecast the future of a relationship (is it worthwhile) on the basis of projected rewards and costs. The theory states that self-disclosure occurs in stages.

**Five stages of disclosure** (Altman and Taylor)

superficial

political

religious beliefs and attitudes

deeply held fears and fantasies

concept of self

According to the theory outer stages occur more rapidly than inner stages, self-disclosure is reciprocal.

**Communicator style** (Robert Norton [1983])

The theory states that Individuals have a predominant manner or style in which they communicate. People communicate on two levels, what they say, and how it is to be interpreted and responded to. Norton calls them style messages, delivered before, during or after the primary message, such as talking in an authoritative voice. Experience helps people identify the style messages and styles are not totally individual, cultures affect how people behave and how they perceive others.

Styles can be classified as

Open Style

Dramatic Style

Attentive Style

Each style is a combination of variables such as dominance, dramatic behavior, contentiousness, animation, impression leaving, relaxation, attentiveness, openness and friendliness. Some go together, such as dramatic behavior and animation, attentiveness and friendliness.

**Media Richness Theory:**

The media richness theory was proposed by Daft & Lengel (1984). The theory refers to the ability of different media to convey messages that communicate rich information. Richness is defined as the capacity of a media to share meaning. The media richness of a medium is the extent of the features such as feedback, multiple clues, language variety and personal focus are present. According to the theory more complex the message is, the richer the medium need to be for effective communication.

According to this theory face to face is the richest communication medium in the hierarchy followed by telephone, email, letter, note and fax

**Social Influence models: (Fulk, Schmitz & Steinfield 1990)**

The social influence model predicts that the choice of an individual to use a particular communication medium is influenced by colleagues and other organizational considerations. Reichwald & Goecke (1994) in their study of air force managers says that there are three key factors that influence communication for managers: innovation and leaps in telecommunications, globalization of business and management processes, and mobilization of managers. All these influence corporation structures and the task related use of telecommunication media.

**Critical mass theory:** (Kraut, Cool, Rice & Fish 1994)

The theory states that , individuals can only benefit from a communication medium if others in their communication network also choose to use the same medium. Cost and benefit of communication systems have a social component that is time dependent. Costs reduce and benefits increase with the growing number of people using the system. The success of any new means of communication is when a large amount of the population accepts the new system.

### Casual interaction

Casual interaction is the spontaneous and unplanned interaction that occurs when people share a common space. Examples of casual interaction are interaction between friends, family, or people who share a common space like in the case of passengers in a train.

### Formal and informal interaction compared

Formal	Informal
Scheduled in advance	Unscheduled
Arranged participants	Random participants
Preset agenda	Unarranged agenda
Impoverished content	Rich content
Formal language	Informal language
One-way	Interactive

### The prerequisites for informal interaction

The main prerequisite for informal interaction is the need for visual Channel. The visual channel is very instrumental in establishing topics and identifying a suitable partner for informal interaction. As Kendon and Ferber [Kend73] describe it, sighting is an essential pre-interaction stage of a greeting. Through eye contact the partner acknowledges that he or she is available for conversation. Seeing someone often brings with it a social



obligation to acknowledge their presence with a greeting. In addition, the visual channel is used to establish the opportunity for conversation. That is, by looking at a potential target of conversation, the initiator can often interpret the target's focus of attention and infer whether and when he or she is available for conversation. (Robert S. Fish, Robert E. Kraut, Barbara L. Chalfonte)

Even though gaze is the most important when it comes to identifying partners for interaction it is not the only one. When people ate at a distance from each other gaze is not just enough so people use gesticulation to supplement the loss of one mode of acknowledgement.

### The aspects of casual interaction

**Concentration of suitable partners:** This implies that any medium which is designed for casual interaction should provide access to a suitable group of others. This happens in the case of people on a train where there is a group of people who are available for interaction. In the case of the internet it is chat rooms or instant messengers which bring people together.

**Co-presence:** As the word implies for casual interaction to occur there is a need for a space or activity that brings people together, they have to be in the same space at the same time. Examples of these spaces are canteens, classrooms, social events usually where people convene.

**Low personal cost:** This implies the effort needed to initiate and conduct interactions. Thus any system that is designed for casual interactions should be of low personal cost. In hostels meeting friends and indulging in casual interaction is as simple as going to their room. In the case of our class, interactions increased when we



were all on one floor of the hostel. High personal cost is also a reason for video conferencing systems not being popular.

**Visual channel:** Visual channel as explained earlier is one of the most important factor in informal communication. It serves as a means to judge who all are available and if they are free for conversation. In the case of instant messengers the lack of visual feedback of whether the person is available or not for conversation is overcome with the use of stating user status, like busy, at work, away.

WhiTaker and O’Conaill proposed a communication framework which consist of four visible behaviors gaze, gesture, facial expressions and posture

**Gaze:** gaze refers to the direction of one’s visual glances and the amount of time spent in doing so. Gaze provides visual cues of who is around, what they are doing, and whether they are available for interaction. If conversation is established, gaze acts as an pointer of attentiveness and provides the listener with visual behaviors from the speaker that help to enrich the communication.

**Gesture:** Gesture is the set of dynamic movements and shapes formed by a person’s hands and arms.” Gesture provides visual cues used to attain reference and help with turn taking.

**Facial expressions:** Facial expressions are visible indications expressed by various facial elements, They provide both the listener and speaker with emotional expression to enhance the spoken conversation.



**Posture :** Posture is the direction of someone's body. Posture generally indicates a conversational interest level.

### Pointers for casual interaction

**Physical proximity:** Physical proximity is one of the very crucial properties leading to casual interaction. The need for people to find suitable partners with minimum effort would foster causal interaction.

**Informal awareness:** Informal awareness provides clues about a suitable partner's availability for interaction. It is gained by the understanding of who all are there, what they are doing, and if they would be available for interaction. In the case of IDC lab informal awareness is got just by observing the persons immediate surroundings, if the person is working on the computer wearing headphones it becomes clear that he doesn't want to be disturbed, thus informal awareness provides clues that influence the way interact with others.

**Privacy:** Altman defines privacy as an "interpersonal boundary-control process, which paces and regulates interaction with others." Issues of privacy are very contextual, when one is in at a public space the issues of privacy are not as important as in the case of when one is at home. Privacy is also very culturally rooted. Care should be taken in the design of a communication system so that privacy of the people involved are not violated. A person through his body gestures and posture gives clues about the level of privacy he would like to have. Boyle (2001) draws on research from Altman to sketch out three key elements of privacy that are necessary to control access of one's self-identity these are autonomy, confidentiality, and solitude.

**Autonomy:** Autonomy is defined by Boyle as “the freedom of will one needs to choose how one defines oneself, and exert control over access to the self.” Like the will to control the camera, to switch it off when ever he or she wants.

**Confidentiality:** confidentiality is defined by Boyle as “control over access to information about oneself that is made known to others and to whom it is made known.”

**Solitude:** solitude comprises of three parts the “freedom from unwanted interruption,” the “control over where one directs one’s attention”, and the “freedom from distraction.” (Boyle, 2001). This is especially true in the case of when a person is working or studying, he would like to be free of distractions. This explains the usage of status messages in instant messengers ( busy, on the phone).

**Self appropriation:** confidentiality is defined by Boyle as is “the expectation of what constitutes socially acceptable appearance or behavior.” The nature of a person in a office is very different when he’s on holiday with his family. His behavior and dressing would change considerably. Thus supporting self appropriation implies that the medium should provide enough aware ness so that the user able to correctly appropriate himself.

The other important aspect of privacy is that in the real world it is seen that if some one can see you it means you can see him also. This changes in the case of the cyber world, on the net you can never be sure who’s watching you. Thus any system which is designed for casual interaction should make it very clear which zone is visible to others and who all are watching that feed.



### Group interaction

**Group formation:** it has been concluded from studies that the main reason for group formation is physical proximity. In the case of group housing like flats the highest probability of group formation is with people who live on the same floor or have common access. In the case of offices it is seen that groups are formed with people who are close proximity to each other. In the case of institutions it can be seen that groups are formed between people in the particular floors in the hostels.

How and why are groups formed?

The formation of groups is a selective process which is governed by a variety of factors. If a number of people are thrown together for some reason, what will determine whether or not this collection of people becomes a functioning psychological group?



Groups develop along several lines. They develop with respect to membership and size, but they also develop with respect to the activities they engage in, interests and jobs.

People who lived close to one another became friendly with each other, while people who lived far apart did not. Mere “accidents” of where a path went or whose doorway a staircase passed were major determinants of who became friends within this community.

## Experiments Group chat

**Intent :** Casual group interaction is a complex phenomena where visual feedback plays a very important role, body posture, gaze, gestures all play an important in initiating and sustaining a conversation. The intent of this experiment was to find out how much of visual detail was needed to start and sustain casual group interaction between friends.

**Experiment:** A group of friends ( seven people) were asked to spend some time during a power failure. The incident was never planned so the groups didn't get to decide any topics. The ambient moonlight was just enough to see the silhouette of people. So people can identify who the other was.

**Observations:**

People started to talk about a magnitude of topics ranging from the days events to gossip. The others showed their involvement by head movement and audio clues.

Turn taking was done by either first getting the others attention by hand movements or by standing up.

It was observed during the interaction that people started gesticulating a great deal.

When a new guy joined the group there was a lot of action as there was mystery and humor in process of guessing who the new guy was. So the whole group burst into laughter as people passed comments about the new member.

It was observed that people touched each other to get each others attention when they were sitting close.

**Inferences:** It became clear from the experiment that there is no need for high visual detail to support casual group interaction between friends. Since people coped with the missing facial clues by gesticulating a lot more. A whole new vocabulary seemed to develop to cope up with the situation.

**Video window:**

**Intent:** The intent of this experiment was to find out how people coped with the absence of one of the communication channels and the reaction of people to a media window.

**Experiment:** The experiment involved connecting two labs at IDC using web cams. There was not much interaction between students of the two labs since they are situated on different floors. The Two web cameras and Microsoft net meeting was used for the experiment.

**Observations:**

The video window created a lot of interest and people started crowding around it.

Since audio was not enabled it was observed that people started evolving their own methods for communication.

They started using placards and started showing gestures for simple words.

The third day the amount of interest went down and had occasional usage.

The video window was again tested after a week and this was looked upon with a little apprehension, people started asking why I was putting up a spy window and who was watching the feed.

There were cases in which when people called up the other lab and got the answer that the particular person is not there they checked the video window and told that that person is seen on the window.

**Inferences:**

The initial interest died down since there was nothing involving about the view to the same space.

People started become suspicious since there was no clear indication of what's the zone of view of the camera and who was watching the feed.

The users developed their own methods of communication using placards and objects.

The video window to a certain extent infringed into the privacy of the users because of its high definition video.



### User groups:

User groups were decided based on the nature of interaction preferred. The groups thus explored were

Dispersed families  
Family friends  
Dispersed friends  
Remote offices

**Dispersed families:** This was a group where the children were working in a geographical different location and thus were away from their parents. The case I had taken was a group where Mr and Mrs Chandran, who had become grand parents very lately and they were worried about becoming strangers to their own grandchild and wanted to become an active part of the their grandchild's development.



**Family friends:** this was a group which consisted of two families who were neighbours and now they are in different geographical location.



**Dispersed friends:** This group consisted of friends who formed a close group in college and spent a lot of time with each other. The friends now are working in different geographical locations, some of them outside the country also. Few of them who work in the same city get together now and then.



**Remote offices:** this group consisted of people who were part of one parent company but were in different geographical location. They lacked the sense of being part of single family and they associated more with their office and not much with their parent company.

## Study

Study was done to identify the interaction in the groups and answers to the following questions were explored

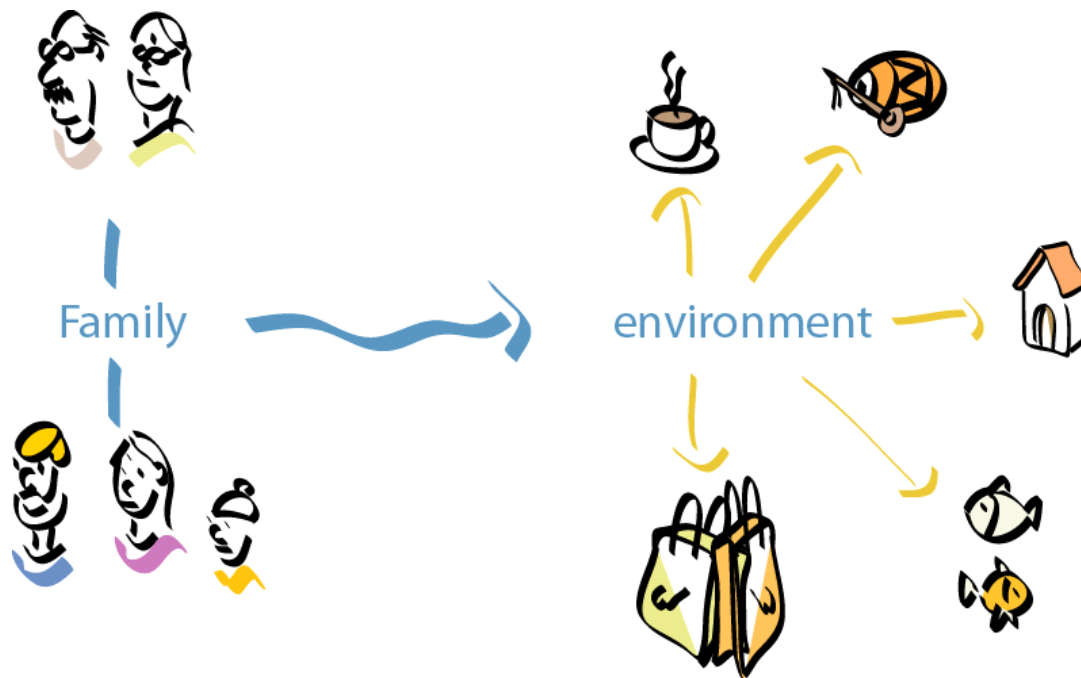
When do they interact

Who do they interact with

What do they engage in when they interact

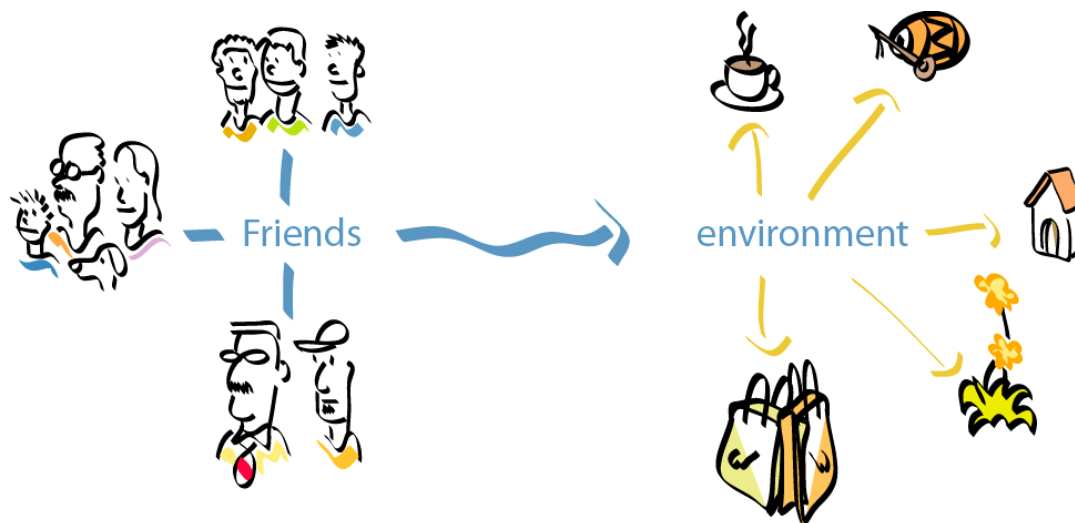
What all environments they interact in

The needs for such interactions



### Families

In the case of the users I had interviewed the daughter interacts more with the in laws than the son. When there were together the grand parents spent a lot of time with the grandchild. They used interact in the following environments restaurants, functions like marriages, festivals, at home spend time shopping and going to the local aquarium and the beach.



### Friends

Friends group can be classified into family friends, classmates and colleagues.

**Family Friends:** In the case of family friends the interaction happened at each others home, restaurants, social functions like Childs birthdays, festivals and marriages.

**Classmates:** classmates group met during weekends, they played cricket, had meals together, went for movies, watched cricket matches together, attended each others birthday parties, met up at the beach and went for shopping .

**Colleagues:** colleagues met up during breaks and had coffee, met up during lunch breaks, they met up after office hours, and during holidays. They spent time shopping, having food, watching matches together at the canteen, smoking on the corridors and chatting during office hours.



### Media analysis:

A study was done to find the activities these groups engage in and the topics that come up when they interact with each other and to identify the different medias they use.

Activities	Medias
Class, professors, computers, daily events, news, movie, music, gossip, clothes, sports, cosmetics, beauty, work	voice. visual mobile
Daily events, children, tv, family matters, clothes, photographs, movie, music, play	voice. visual, white board haptic
gossip, problems, music, festivals, holidays, events, meetings, movies	voice. visual, mobile
Music, movies, sports, games, jokes, art	voice. visual, mobile, white board



### Emotional aspects of casual interaction:

Users were asked to give a one word description of the emotional aspects of casual interaction and this process generated the following list. Users said that to them casual interaction was Close, special intimate, sharing, memorable, creative, spontaneous, sweet, personal, funny, fresh, everlasting, cozy, familiar, connected, trust, informal, unplanned, spicy, naughty.



### Environmental Clues

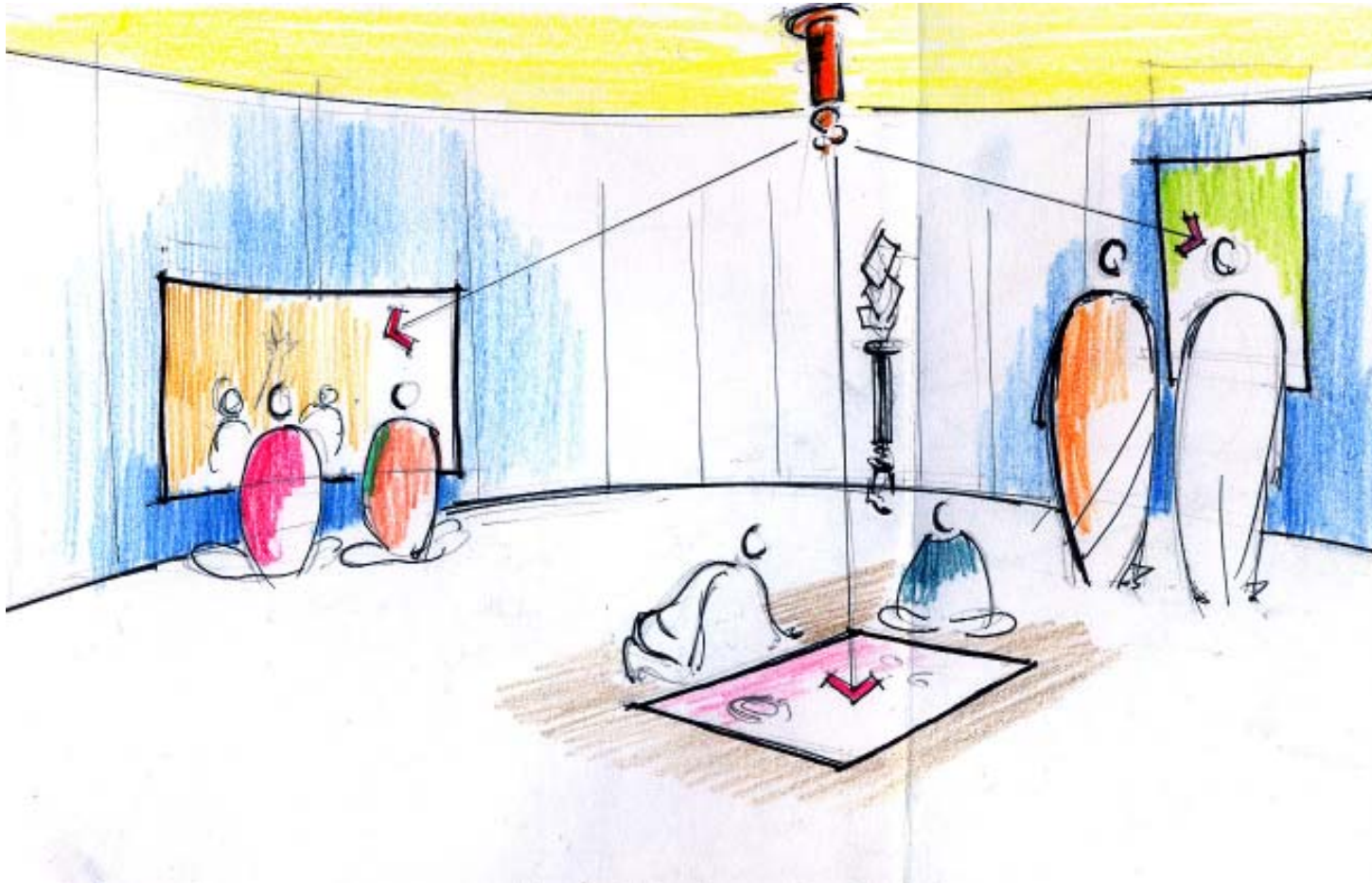
Study was done to identify the objects which were present in the environments in which the users interacted so as metaphor to generate product form.

The following list was generated:

Table, Couch, door, vase, mats, games, posters, book, toys, ceiling, floor, fan, mug, tv, chair, rug, mobile, ceiling, window, wall.

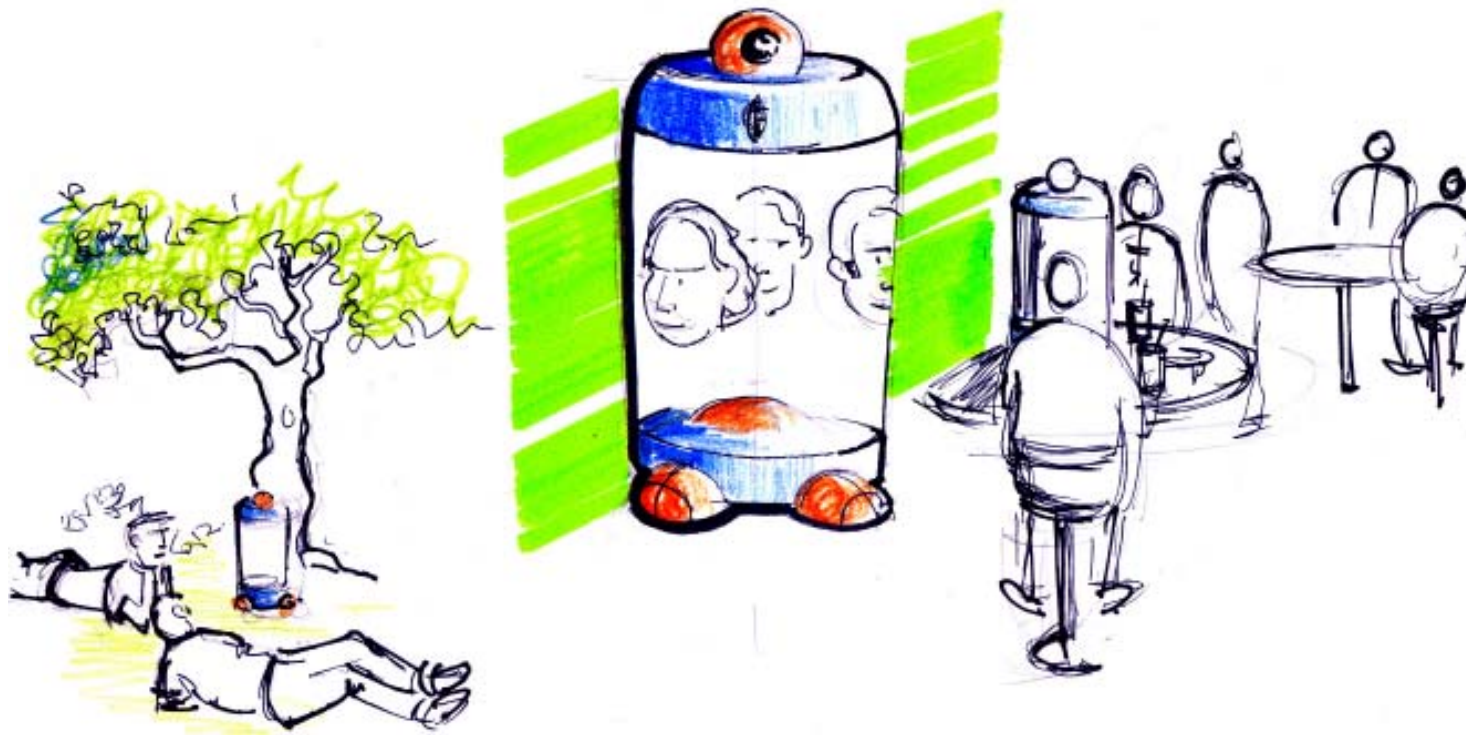
## Design Ideas

Personas were made for the earlier mentioned user groups and this served as basis for idea generation. The design approach here was to integrate the interface with everyday objects in the environment in which these groups interacted in so as to make the technology truly invisible.



### The media space:

The media space was designed for family friends. It consisted of a single projection source projecting on various surfaces depending on the type of interaction the user requires. The wall becomes the interface if the users are facing the wall, on the floor if the users are sitting down, on the table if they are seated around one. These are pre decided interaction areas so that they could contain sensors which trigger the projection source and also contain audio and video capture and output devices. The product catered to the scenario of formation of subgroups by supporting simultaneous conversation happening at different location ( this phenomenon was observed during the study of family friends group) with one device and making the device ubiquitous by integrating the devices into the environment.

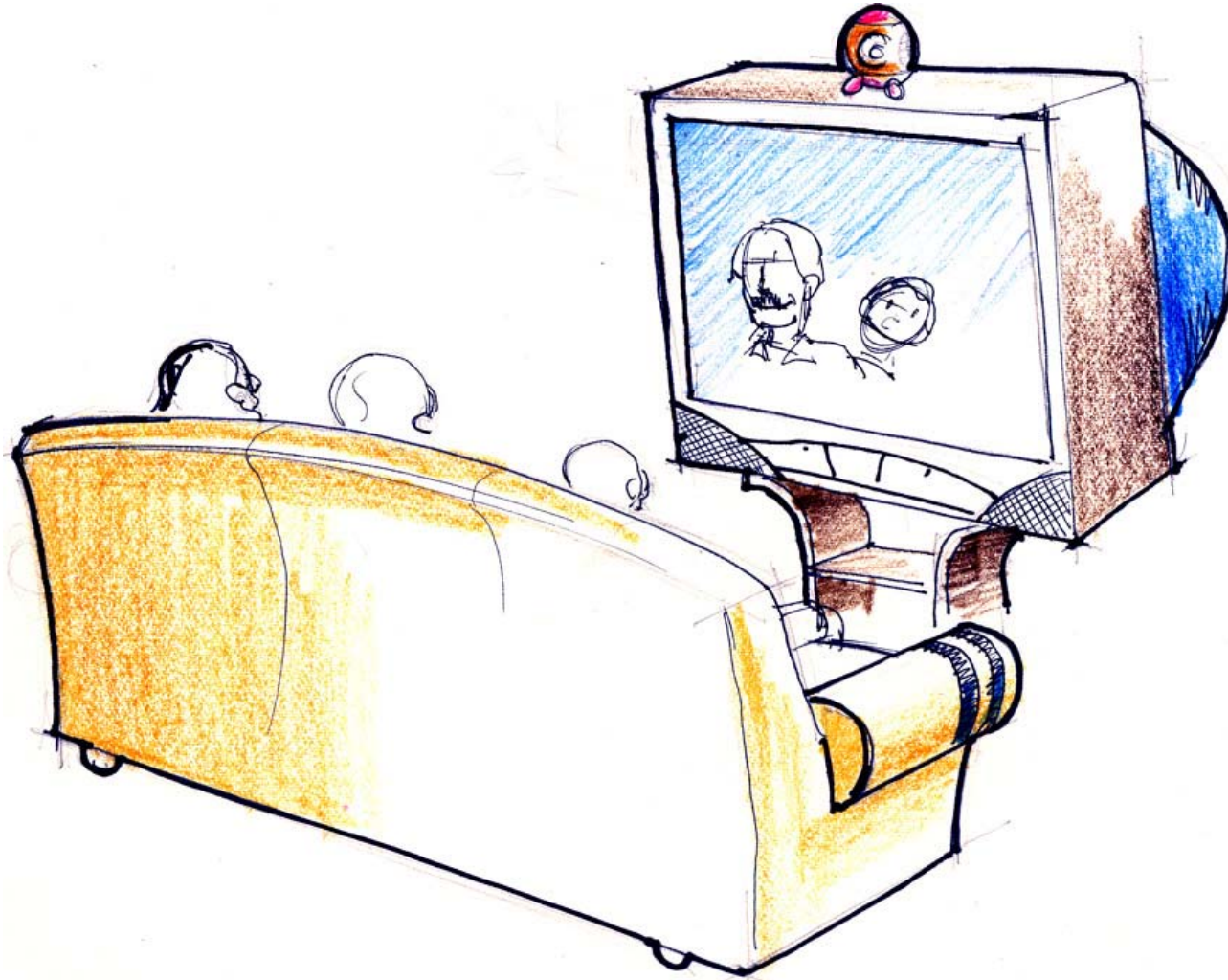


### Portable friends:

Portable friends was an idea intended for dispersed friends. The device is a portable and integrates the input and output devices into one single unit. The device thus truly can be put into any environment. The device has a cylindrical transparent screen, where by faces can be seen from both surfaces, like if you are seated on one side you would be seeing the back side of your friends faces. The device just captures faces and projects it on the similar device on the other end. Thus it doesn't matter on which side of the device you are seated since you would see all your friends. Here I tried to solve the problem of gaze and problems associated with spatial orientation of the users.

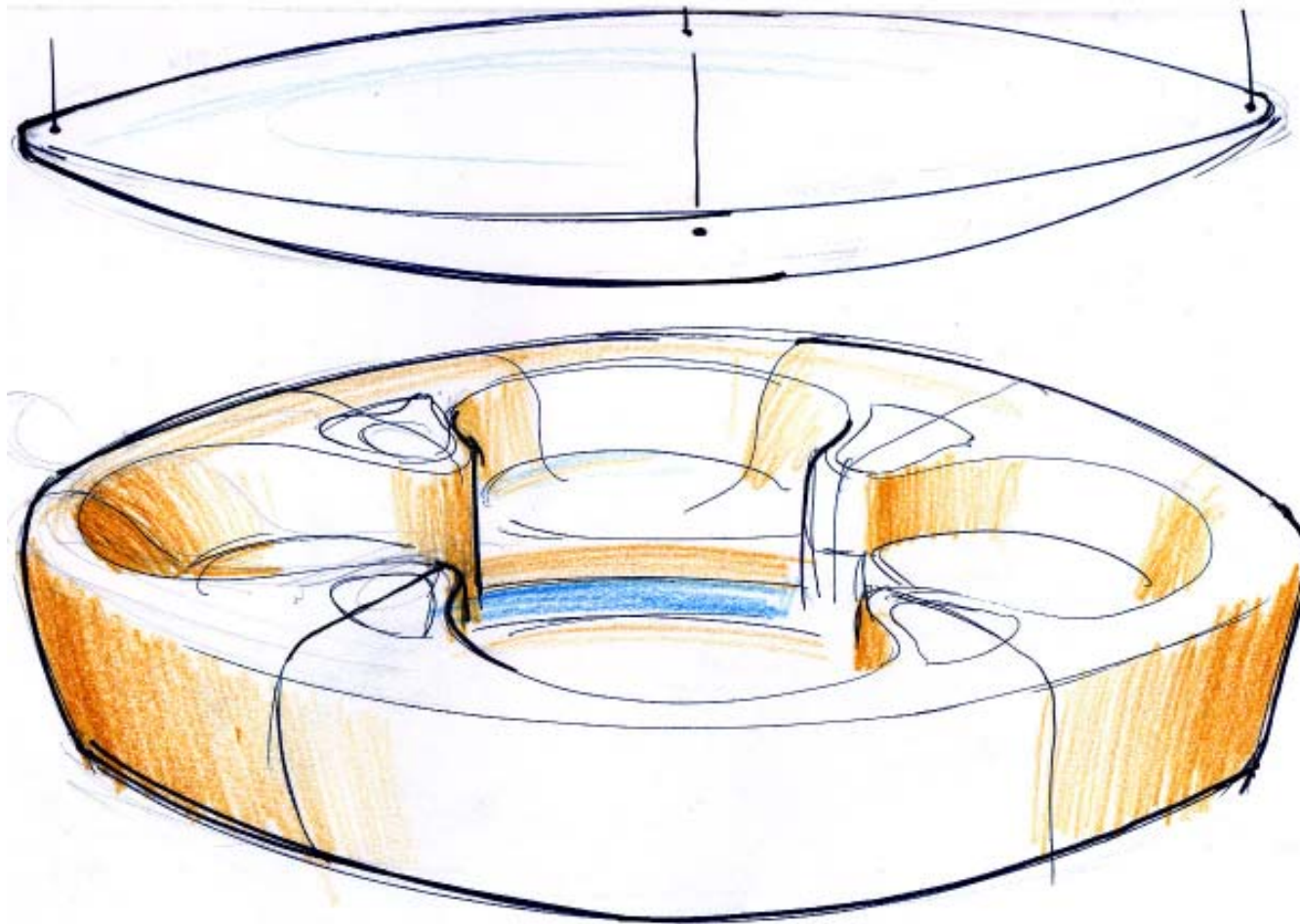
**Kids view:**

Kids view was meant for people who wanted to be part of the growing up process of children, typically the case of single parents and grandparents. The device consists of a camera and projection source kept at the top of the child which transmits data to a flat display device. Here care was taken to orient the cameras and screens to match with the point of view of the subjects. Usually children are placed on mats on the floor and the device was conceived to match with this habit.



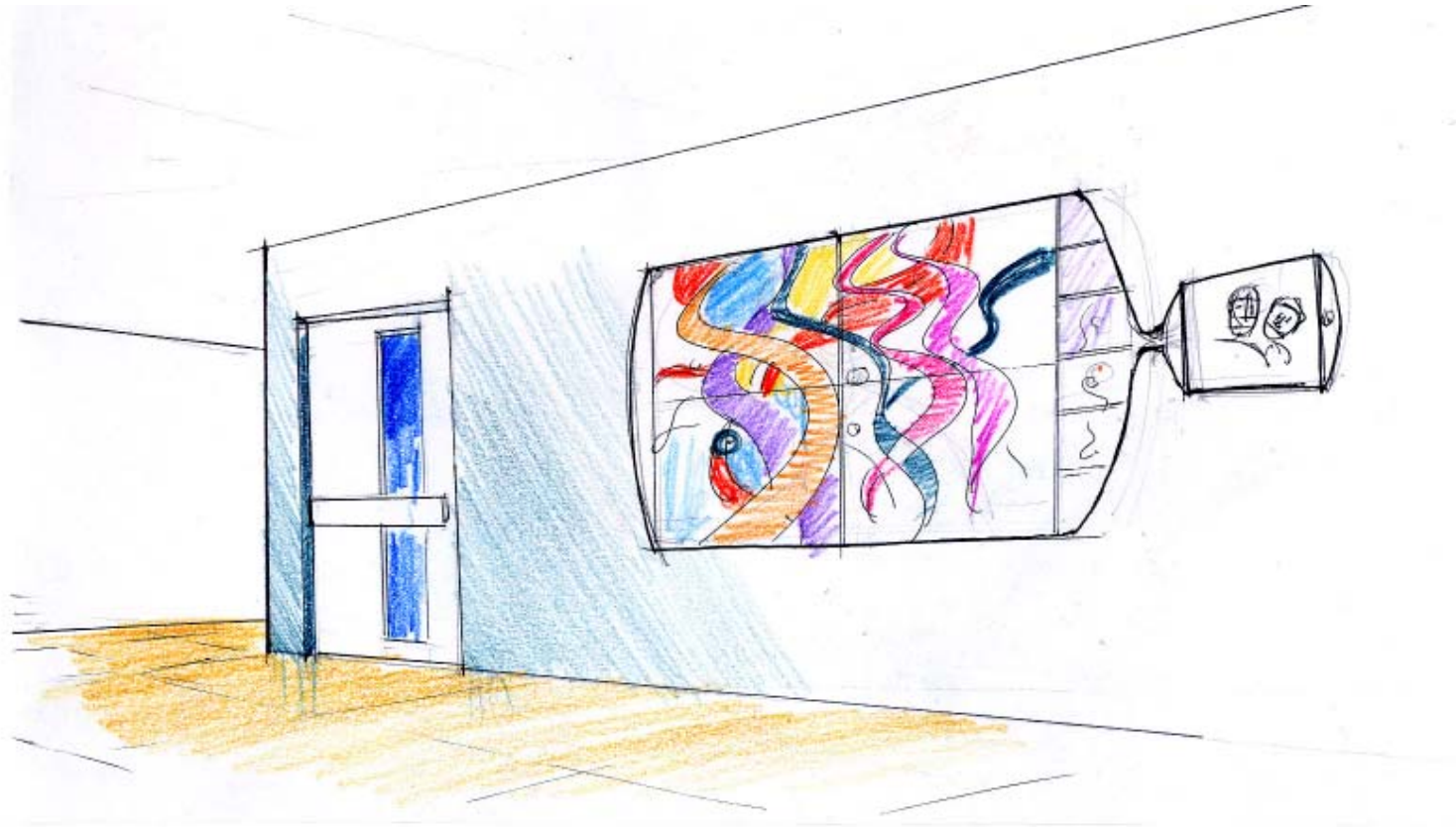
### TV

The user study revealed that users spend a lot of time in front of the TV with their families. So television itself could act as a group interaction device if coupled with a capture device. Since the cable carries internet too it would be an ideal device for interacting over the internet. Thus there is no need for a dedicated device for group interaction.



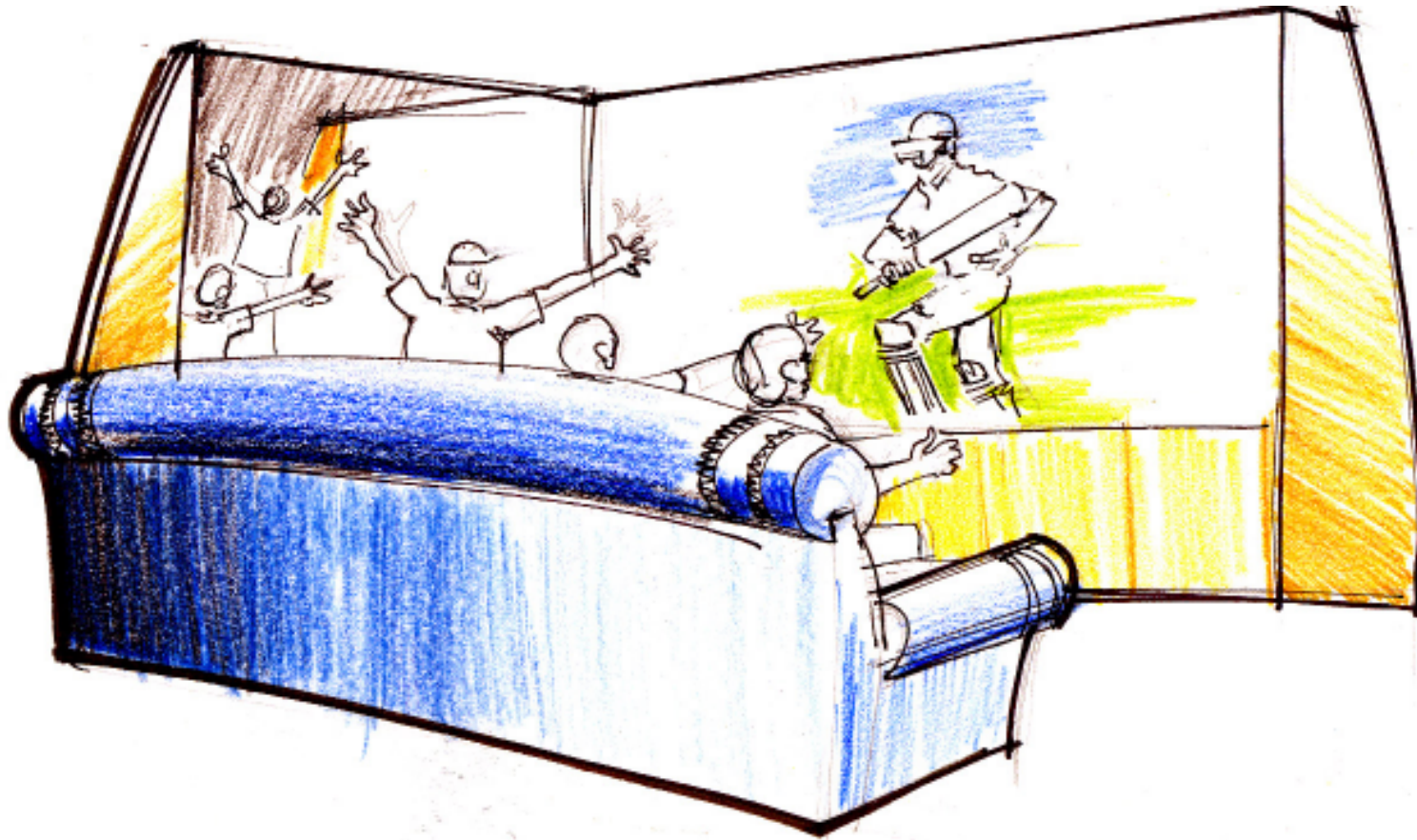
### Share and relax

The motivation of the idea share and relax came from the experience of being in a Jacuzzi. It is the relaxing and tender experience which makes it special. The idea consisted of a set of four seating areas with haptic feedback arm rests. The ceiling had a spherical screen on which was projected the feed from the remote unit. The camera points downward. The device allows one to have a relaxed and enjoyable experience with the loved ones.

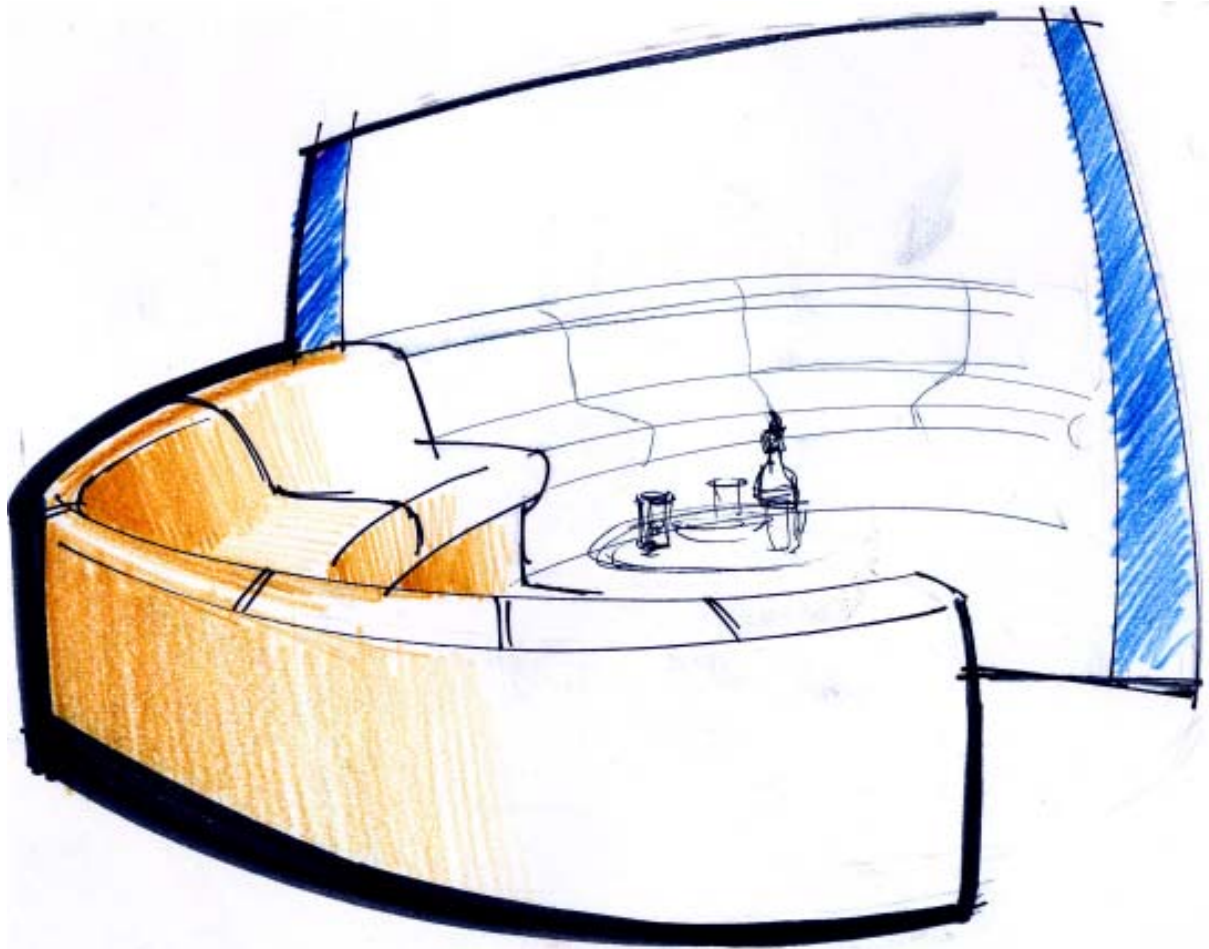


### Corridor dynamics:

Corridors are the main interaction areas in offices, people spend time chatting with friends on corridors it acts as a public space. The idea was to connect up to corridors of two remote offices so that it allows a window into each others world and thus creates instances for people to start interacting. The idea of a window to the other space came from the feedback that friends used to talk about people dear to them so much that finally it seems to others that they have been there and met those people.

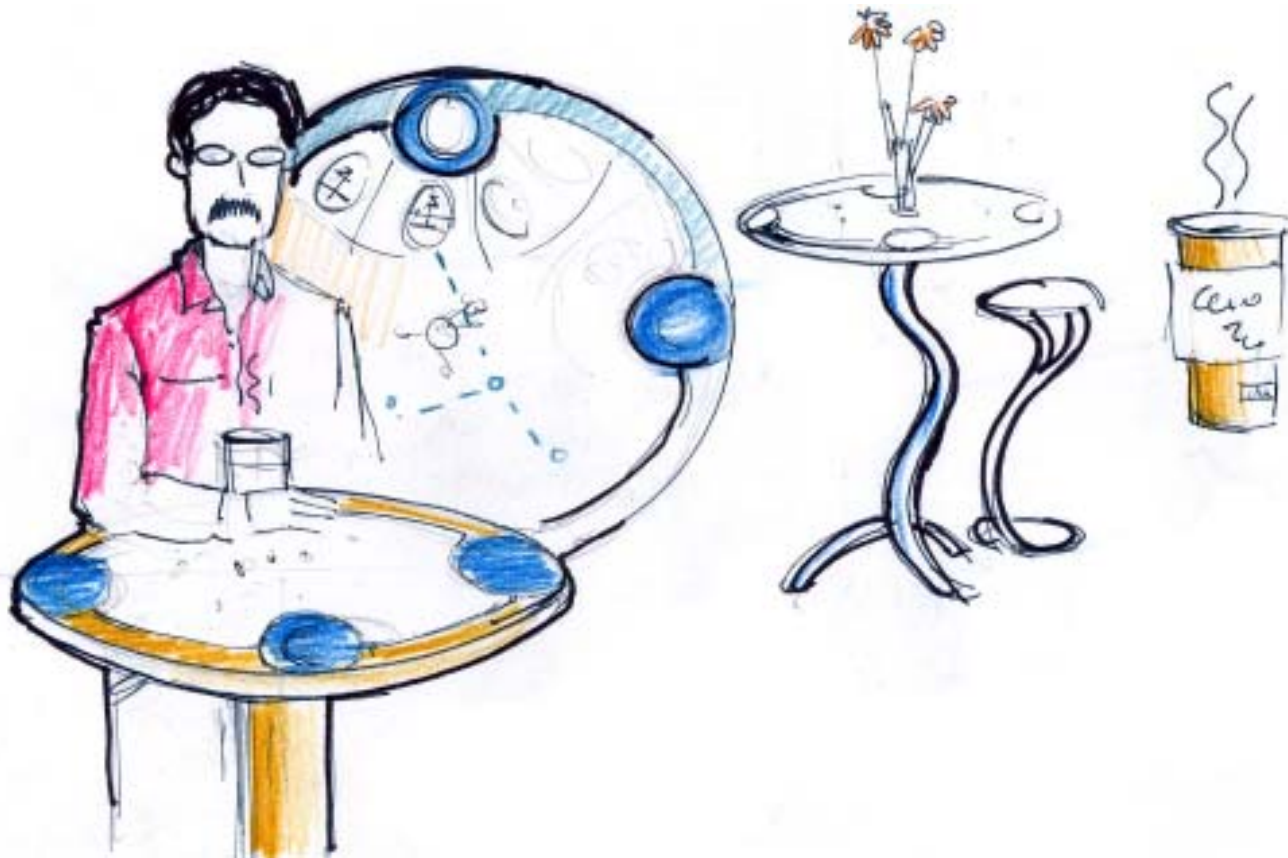
**Group action:**

Viewing sports especially cricket was always a group activity, friends used to meet up at each others house and watch the match whole day and it was the aspect of being with friends and cheering together that made the experience more memorable and fun. Group action consisted of a screen which connected the two remote spaces and another screen perpendicular to this screen on which the match is projected so that it would create an experience of watching the match together.



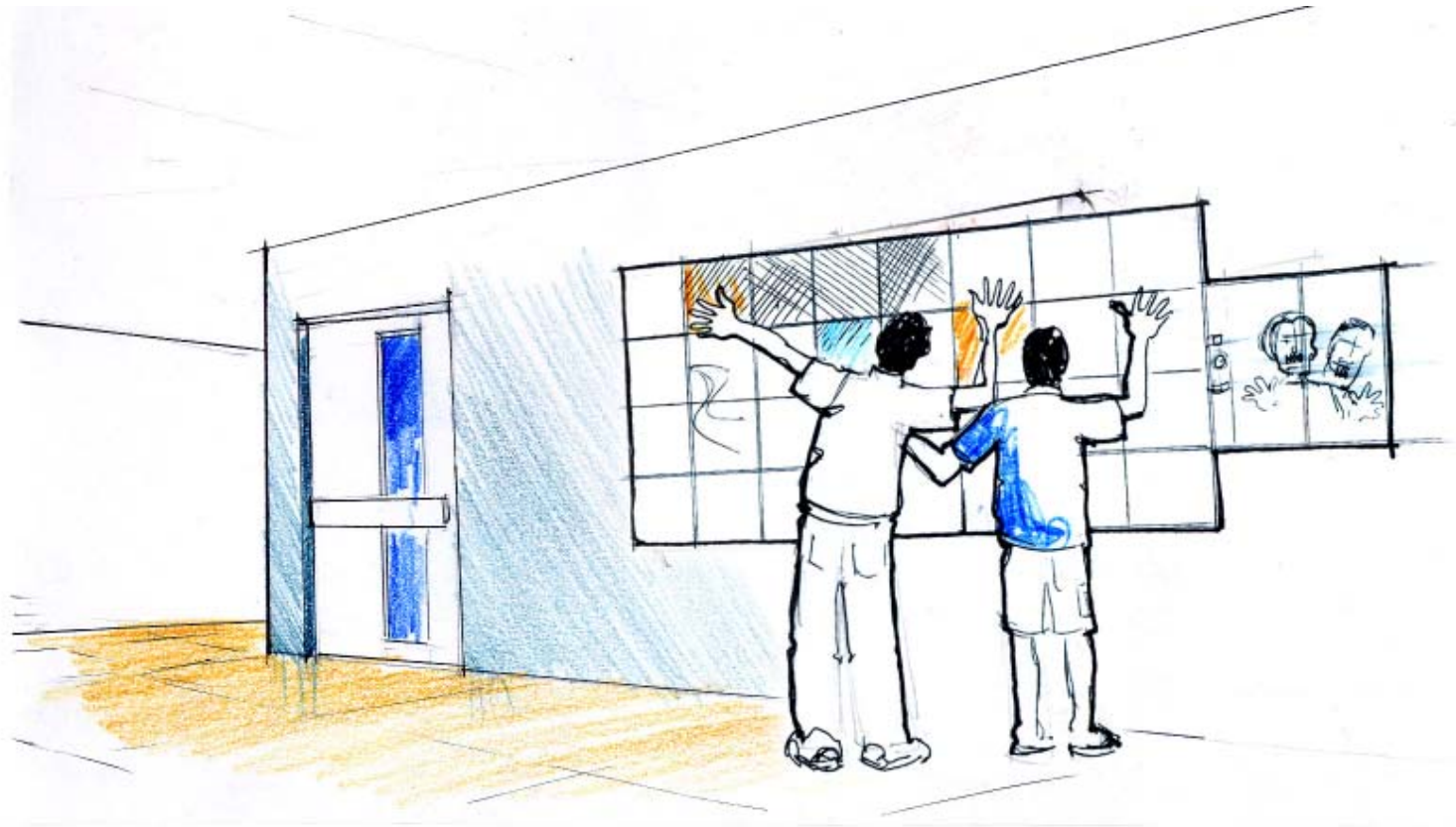
### Share a meal:

This idea carted to almost all the groups, from my user study I understood that people usually met at parks and would move over to a restaurant and start interacting there. When ever friends would get together the most preferred place was their favorite restaurant. The share a meal had a screen which provided a view of the other world and the furniture was integrated into this display so that it matches with the furniture on the other end thus forming a seamless space which connects these two worlds.



### Group search:

Group search was designed for office cafeteria and is in the form of a coffee table. It was observed that the main interaction areas in offices is the cafeteria. The table helps people form groups which in normal case form due to proximity (groups form among people sitting close to each other) The user can log on to the network and look for people with similar interests, he can leave messages for other uses. The table also allows users to connect to another table in a geographically different location thus it not only allows for casual group interaction but also helps in formation of groups.



### Corridor group fun:

This was similar to the corridor dynamics idea but here the virtual window consist of video and voice cubes. The wall gives a diffused view of the remote corridor thus giving a user anonymity and he interacts by touching the video cubes thus generating visualizations which would prompt the user on the other end to reply back. The audio cubes in a similar way generate musical notes. The device thus creates instances that prompt people to start interacting. The anonymity makes the person open up and start interacting, as would have happened in the case of internet chat.

The design based on personas and environments created a magnitude of design solutions. These were shown to users for feedback.

A lot of people liked the share a meal and group action since ideas since it seemed so simple and natural way of interacting.

The corridor fun was appreciated by people because of the casual nature and the anonymity provided.

The corridor group fun was appreciated for the involving, fun and dynamic nature of interaction. Users commented that they could create interesting music if they connect up with their friends on the other side.

One user commented that he could ask his group of friends in the other office to come over to the wall so that with the use of a mobile phone they could have a very personal interaction which would be so enriching because of the visual feedback.

**Vision:**

To connect up two remote offices so as to build a bond which makes the employees feel they are part of a complete family. To create an experience which is playful, involving, magical, memorable and natural.

**The remote office**

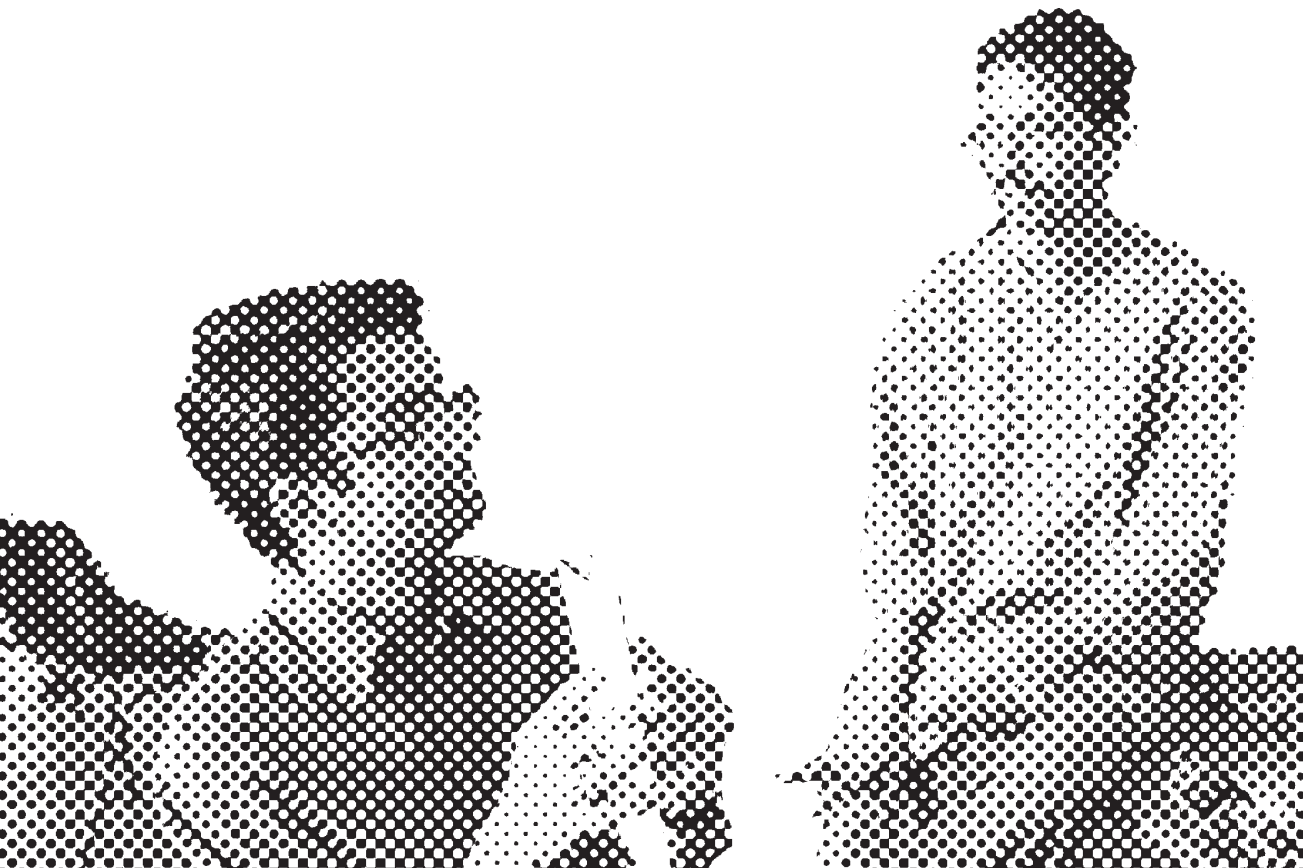
As part of my user study I had interviewed employees at P&O Netloyyid, a multi national shipping company. The interview with users at P&O Netloyyid revealed that in their daily communication with their offices in Holland, Hong Kong and US they didnt have a sense of time. Their job calls for working at odd hours since they have to match with the time at the remote place. It became very clear from the interviews that there was a need for these users to get to know about the states of the environment at the others end. So that the other office and their friends they have made through their everyday interactions are more than just names and time slots. They expressed the desire to reach out and interact with their counterparts at the other end.

**The vision**

To connect up two remote offices so as to build a bond which makes the employees feel they are part of a complete family. To create an experience which is playful, involving, magical, memorable and natural.

**World on the wall:**

The world on the wall connects two remote offices. It consists of a full wall sized display (2 m x 3 m). The wall at location A reflects the changes happening at the location B and visa versa. The wall at location A also reflects the reactions of the actions of people at A. When a person at location A comes in front of the wall he sees the view of Location B and also his digital self being reflected on the wall. The digital self reacts to all his actions. This feedback helps the user at A to control his actions and start interacting with the digital entities at location B.



### **A scenario**

Sasi Kallada and Manoj K are employees at a multinational company and their office is at Hiranandani, Mumbai. Their duty starts at 1 pm and goes on till 10.30. They work on the Holland shift and today was a very busy day since from they had been working non stop from 1 o'clock. They usually go for tea at 7.30 pm in the office kitchen. The world on the wall is situated in the corridor close to the kitchen and is connected to the corridor at Amsterdam office. Sasi and Manoj spend time with their colleagues in the corridor during tea breaks. When they come in front of the wall they see their digital self on the wall. The wall is very bright since its 3 Pm at Amsterdam. The whole wall had a dark tint of blue showing that it's very cold in Amsterdam. They could see that there are people logged on as their digital self from Amsterdam, Sasi waves to them and they wave back. He could see that they are laughing a lot since the visualizations are very colorful visualizations, Sasi goes

to the wall and touches it creating a ripple and writes a message wishing them good afternoon.

Thomas, Kristine and Mark have had a busy day since they had been working nonstop from 1 pm and they had come for a quick tea. They were worried since they had to finish today's booking before day end and send it to the office in India. On top of it had been snowing all day and to make matters worse it had been raining since morning. It was a really bad way to start the day. As they are in front of the wall looking at the view of the Indian office it seemed to bring a warm smile on their faces seeing the orange glow signifying a warm summer day with plenty of sun. Kristene makes a comment to Mark that she wishes she was in India enjoying the warm sunshine. She leaves a doodle on the wall saying "I wish it was sunny here". Just then she sees this bright ripple created by the user on the other end and they all couldn't help themselves but smile. They touch the wall together thus forming a buddy group.

The world in the wall was to be designed to create instances for people to start interacting. It should allow people to maintain their anonymity so that they are more open to react to the changes on the wall. The wall becomes a space which reflects each and every change thus becomes a device which would prompt people to stand up and take notice.



The following questions were pondered upon while developing an interface for the world on the wall.

What are the instances that would prompt people to start interacting?

Dynamic reflections of their actions and the of the others would catch the attention of the users and this would prompt them to explore further, in doing so connect up with people on the other side. The anonymous nature of the interface would lower their inhibitions and make them open up. The spaces which the world on the wall would occupy are areas where users normally spend time as a group like canteens and corridors. The good part of people being in a group is that they would be bolder to try out new experiences.

What all would people want to know about the space on the other end?

From the interviews I had conducted with people at the two offices it became clear that they wanted to know the environment and seasonal changes occurring at the others end. In case of P&O Nedlloyd the employees in India couldn't relate to their employees comments about the climate in Holland ( snow and wind with occasional rain).

### **Designing the system**

A network diagram was generated for the various factors that would form the input for the system. The main subgroups were environment, architecture, people and objects

The next step was to develop a hierarchy of these inputs so that a system could be worked out for visualizing the changes and the interrelationships. Matrix was created to develop the input, the means of visualization and the scale of the variation.

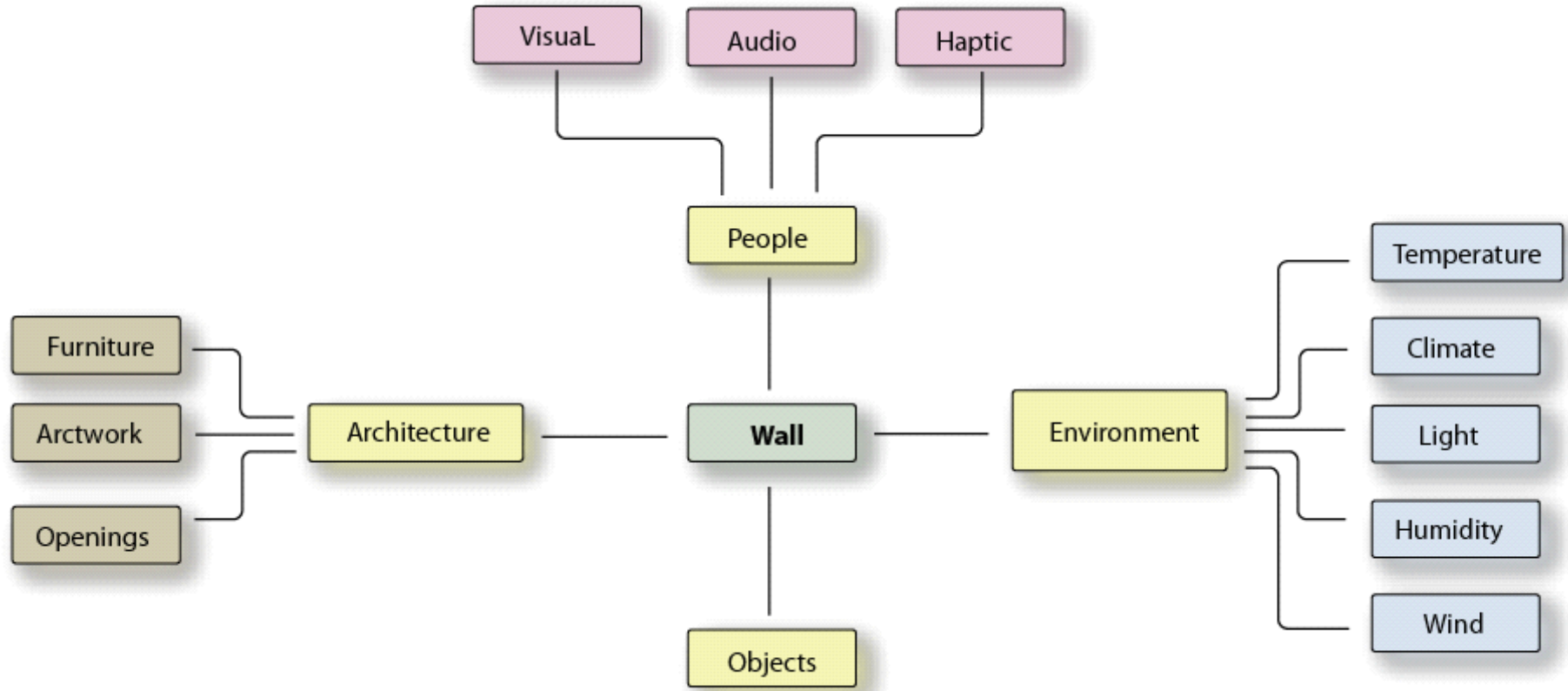
The hierarchy was developed based on the relationships that exist in nature. The hierarchy talked about here is the effect and influence relationships that exist between the various elements. In nature the environmental factors are on top on the list, architectural elements comes next, humans come below this and the lowermost in the order are objects that people use. The hierarchy is developed based on the effects and control the various elements exert on each other. In the case of environment it affects all other elements for example humans are affected by climate, they change their whole lifestyle based on climate. In the case of objects as cell phones

there is a two directional relationship, the cell phones calls for an action from the user if it rings so it is able to influence the user. A grid was developed to study the interrelationships between the elements so as to build a system for visualization.

Any system which becomes predictable becomes boring with the passage of time. So an analysis was done to identify the various ways by which the wall would still be interesting even after a month. One of the approaches was to design at the smallest level, work out the conditions and actions and let the system generate the reactions. This approach was inspired from nature where conditions or forces are what generate a magnitude of visually rich forms. If an equation could be worked out for the smallest unit reflecting the impact of the various forces then it could be used to generate a magnitude of visualizations.

The element of surprise comes from the system being unpredictable and different. One of the problems identified with the above approach was that there could be cases in which the visualization would become really unrecognizable and chaotic. Thus it is a path which needs to be carefully approached since the risk of getting a disturbing visualization is always there.

Another factor that was looked upon was how the world on the wall changes with time, being still interesting a year later too. The question of what all are the things that evolve with time and which still don't fail to amaze us generated the following answers  
plants, people, trends, change, growth, environment.  
Thus it can be inferred that it is the dynamic nature of these that evoke our interest. Thus putting the point I had said earlier in a different way

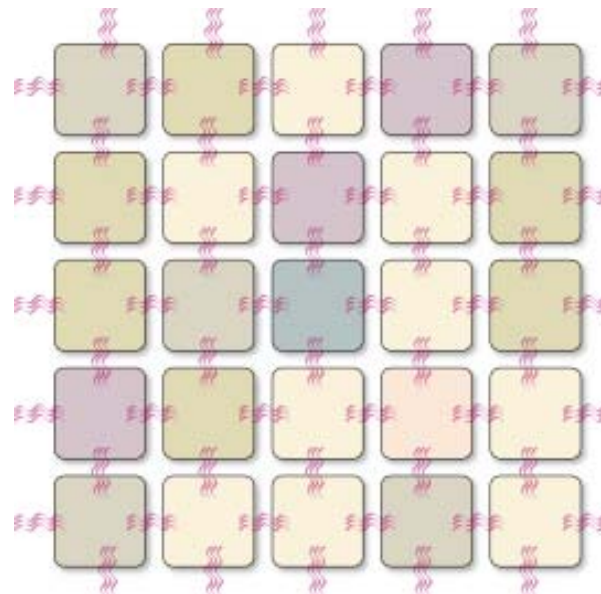


Inputs for the world on the wall

*“Nature never stops to amaze, surprise and intrigue us because of its unpredictability and ever changing nature. It’s a system which allows us intervene, involve and interact with.”*

### Design of the fundamental unit

A basic unit for the whole system was developed based on the understanding that the wall can be looked upon as a digital world which reflects the real world. Thus it can be compared to the cyber world which so many of us are so familiar with. The resemblance doesn’t end there, the cyber world offers us a level of anonymity and privacy that allows us to overcome our inhibitions and open out and connect to people. In the case of the wall we get transformed to a digital self once in front of it. The digital self offers the same amount of freedom and privacy as the cyber world. In the digital world visual forms get converted to pixels thus it was convincing enough for me to take the pixel, a square of one hue to be the smallest unit or the fundamental building block of the virtual world.



The whole system is conceived to be an interconnected system of squares. The units are bonded to the ones surrounding it through an elastic link. Thus any change in one unit would bring about a change in the grid. Each unit has a randomly generated value which changes its reaction to the changes in the environment. Thus any change in the environmental variables brings about a corresponding change in the wall. If the climate is very sunny then the units become very light and the bonds weaken and if there is breeze, they may fly off and a new set of squares develop in their place.

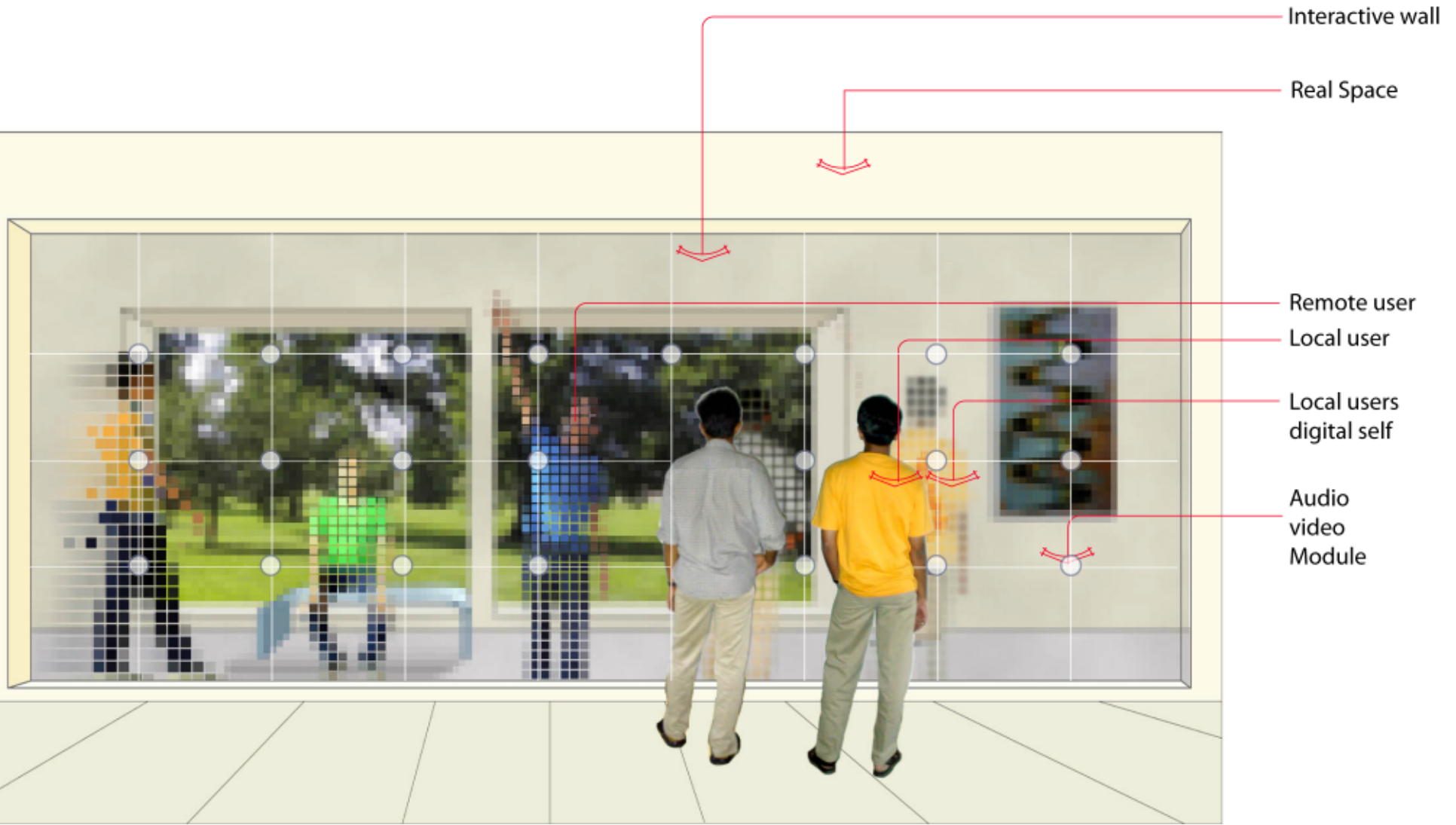
Input		Output A	Output B	scale	AI
Environment	Climate Spring	nil	Random generation of pixels		
	Summer	nil	slow rising of pixels	Speed	The pixelgrid gets energized and starts vibrating with increasing amplitude
	Winter	nil	Falling pixels	Speed	Minimum vibration
	Monsoon	nil	Flowing pixels	speed	The pixelsquares lose shape and become soggy
	Temperature	nil	Color	red - blue	
	Light	nil	Intensity	bright to dull	
	Vegetation	active leaves	active leaves	density	
	Humidity	nil	condensation	Translucence	
	Wind		digital wind blowing of squares	slow - fast	
Architecture	Furniture				
	artwork on wall	nil	movement		
People	standing	digitalsquares slowly fall down	digitalsquares slowly fall down	varying speeds	
	walking	digitalsquares stay behind sound beats	digitalsquares stay behind		
	sitting				
	running	stretching of digitalsquares sound beats			
	hand movement	sound: flute			
Activities	talking	visualization of curved bands	visualization of curved bands	color and amplitude variation	
	whisper	curved color bands	curved color bands		
	shout	high amplitude curves			
	staring	the digital squares slowly start falling down			
Objects	cellphone	animated graphics	animated graphics jumbled sounds	depends on if person is talking or not	
	laptop	leaking code	leaking code	fixed speed	
	briefcase	leaking fonts, stuffed with documents	leaking fonts, stuffed with documents		
	music, mp3	music notes coming out	music notes coming out	fixed speed	
	camera				
	palm top	smal leaking code	smal leaking code	fixed speed	

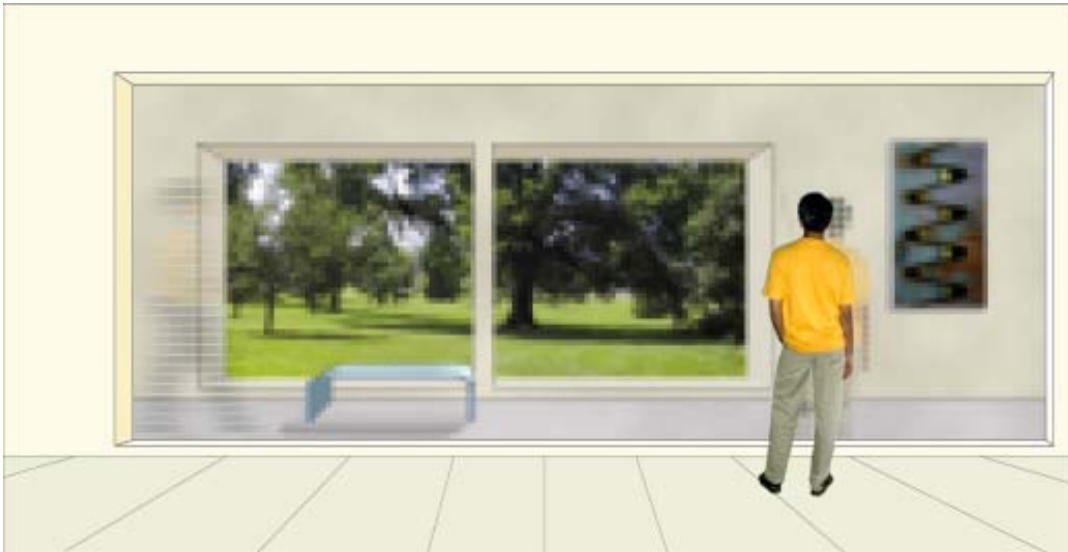
The table was developed to specify the visualizations, the scale and the artificial intelligence reactions.

	Clim ate Spring	Sum m er	W inter	M onsoon	Tem perature	Light	Vegetation	Hum idity	W ind	taking	w hisper	shout	staring	celphone	laptop	m usic, m p3	cam era	palm top
Clim ate Spring	nil																	
Sum m er																		
W inter																		
M onsoon																		
Tem perature	3	5	2	2														
Light	2	5	2	2	4													
Vegetatbn	5	5	5	5	5	5												
Hum idity	4	4	3	5	5	3	0											
W ind	4	4	4	5	4	2	5	1										
taking	1	3	3	4	1	1	1	3	4									
w hisper	1	3	3	4	1	1	1	3	4	0								
shout	1	3	3	4	1	1	1	3	4	0	0							
staring	1	3	3	4	1	1	1	3	4	0	0	0						
celphone	1	1	1	2	2	2	3	1	3	0	0	0	0					
laptop	0	2	2	3	2	2	0	0	0	0	0	0	0	0	0			
m usic, m p3	0	1	1	2	2	1	1	1	2	0	0	0	0	0	0	0		
cam era	3	4	1	3	1	4	3	3	1	0	0	0	0	0	0	0	0	
palm top	1	1	1	1	2	3	1	1	1	0	0	0	0	0	0	0	0	0

A chart was developed to understand the interrelationship between the various factors. They were rated in a 5 point scale with 5 for maximum relation.

The first version of the world on the wall.





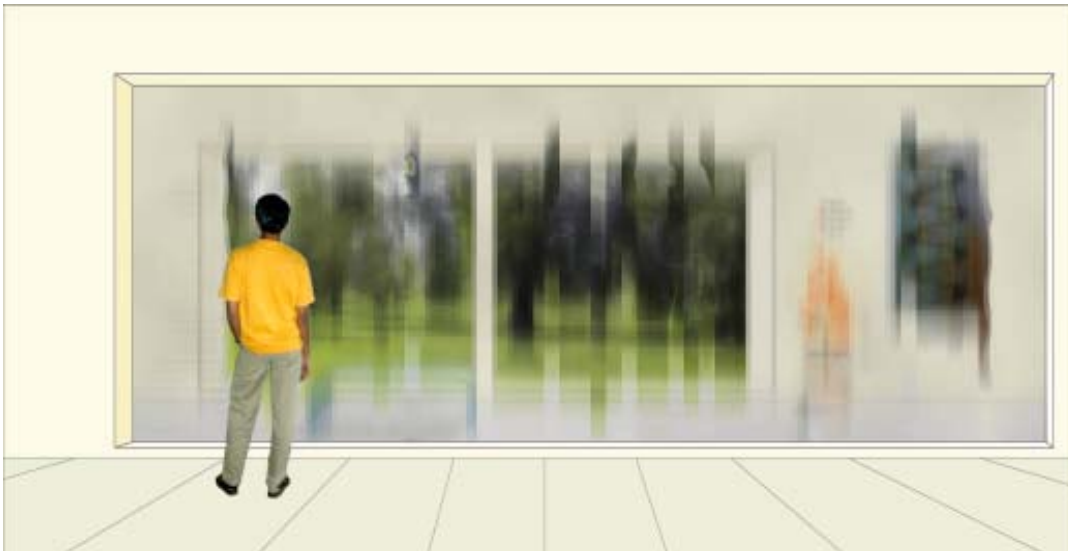
World on the wall



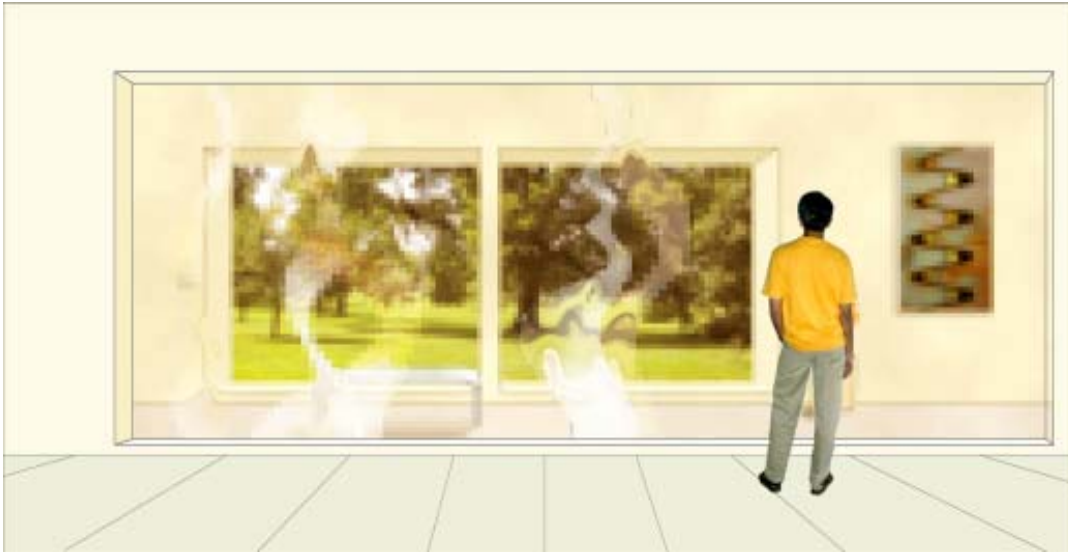
Sound visualization



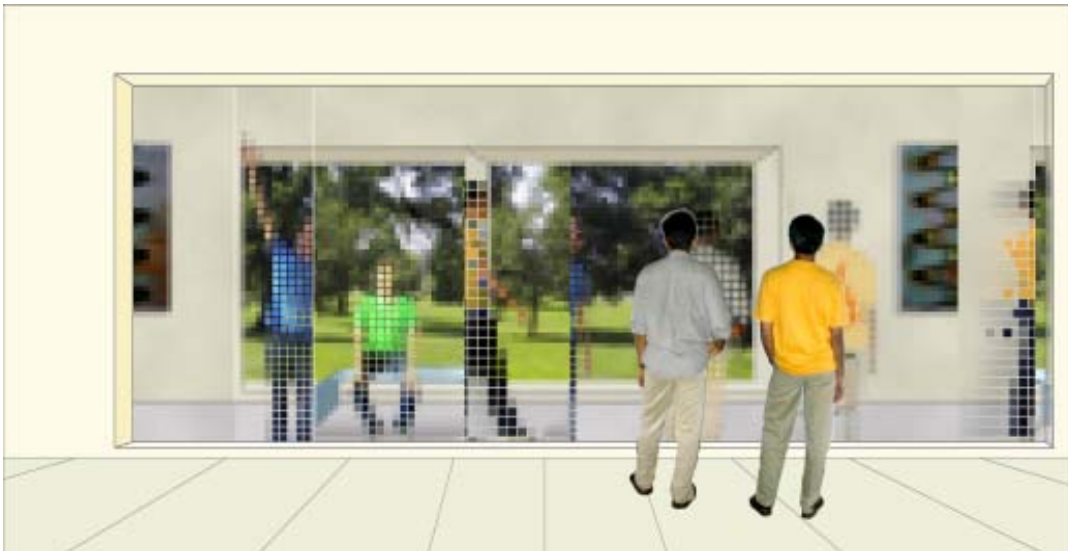
Autumn visualization

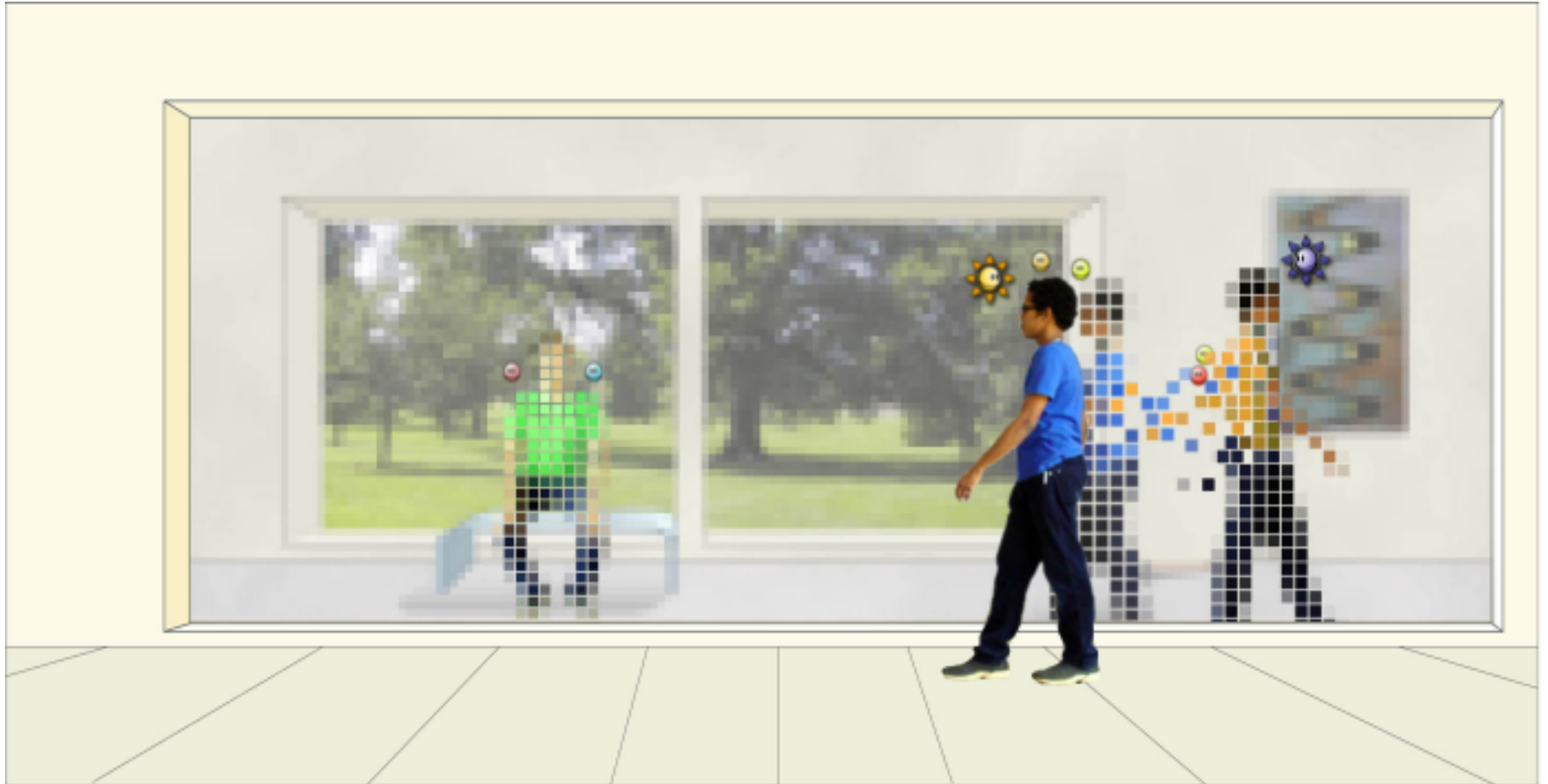


Monsoon visualization

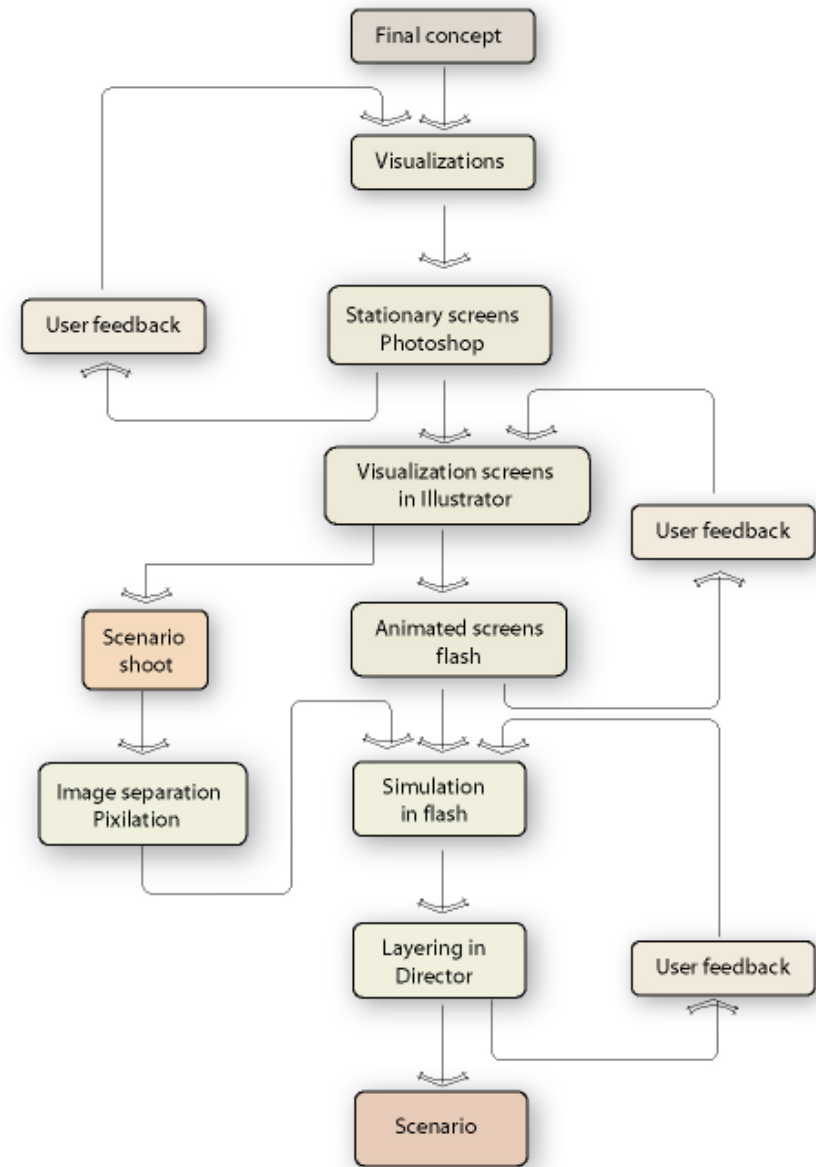


Summer visualization





Buddy visualization

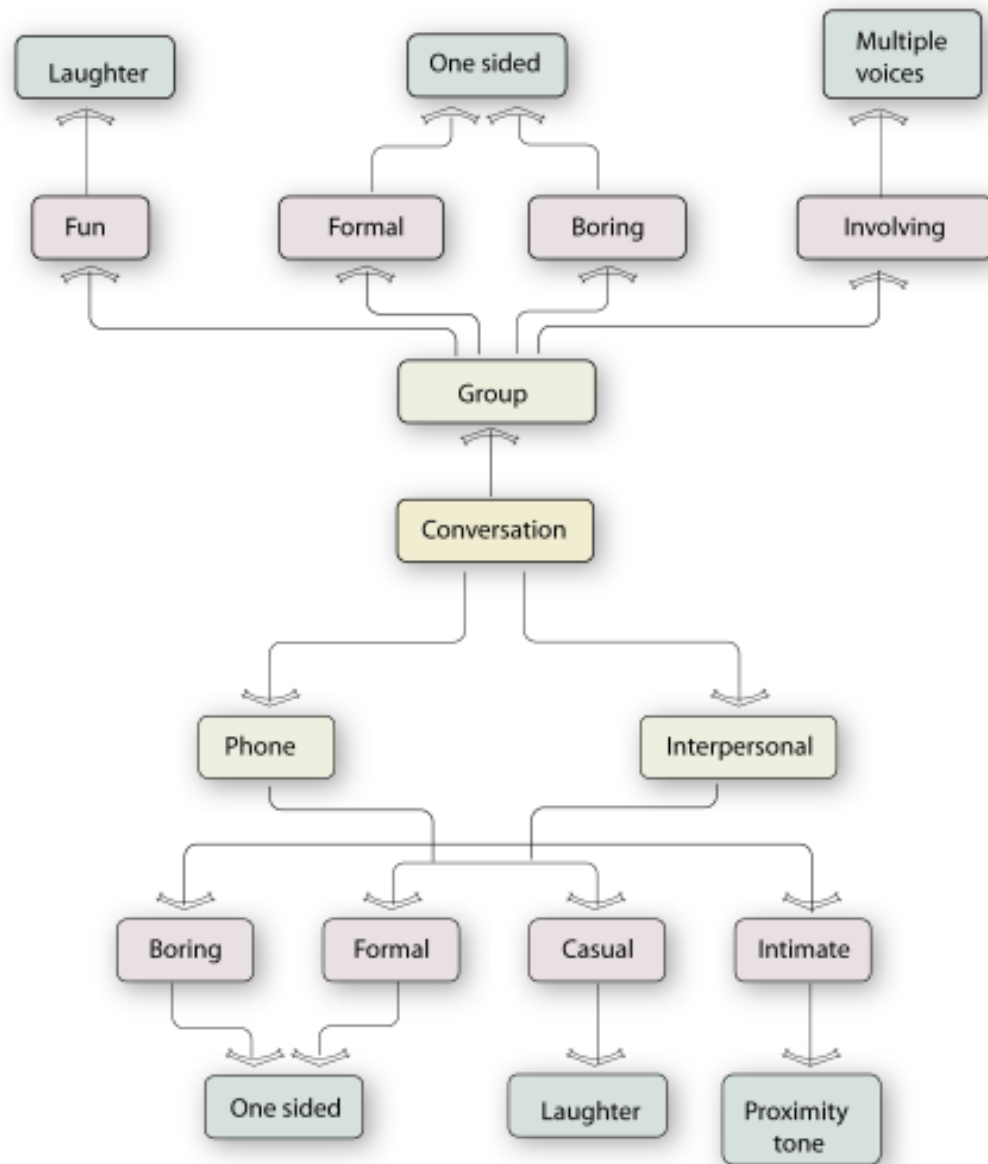


**Methodology for visualization**

### **Visualization:**

#### **Visualizing conversations :**

One of the inputs to the system is sound. Sound can be transformed using various process, it can be stretched, reversed, distorted or can be syntactically substituted. Sound could be looked in terms of its fundamental units, amplitude and frequency. Sound can be divided into various frequency or amplitude zones and each of these could be used to generate a curve. Thus sound is pragmatically substituted. First visualization was generated using this approach and was shown to users for feedback. The users associated the curves with smell.



Conversations can be classified based on the involvement of people in the group as

Formal  
Boring  
Involving  
fun

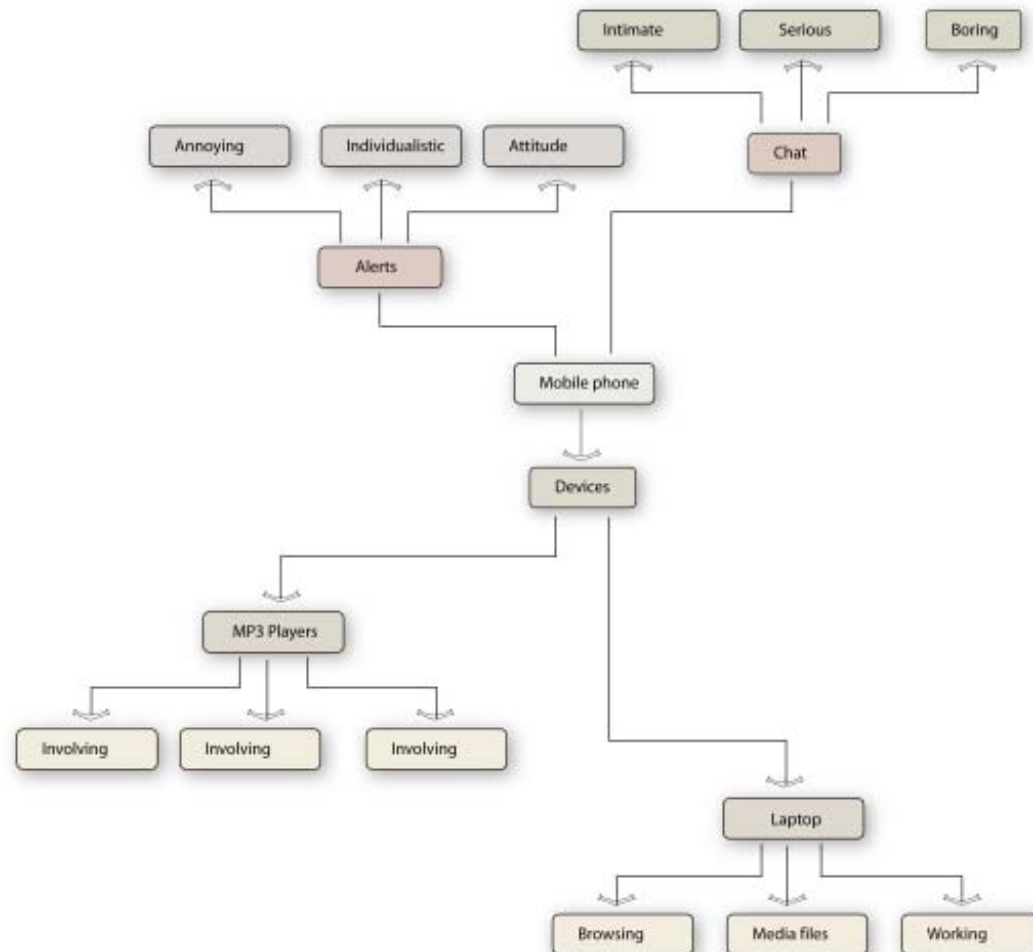
Conversation can be broken up into the above mentioned categories based on simple rules. If there are two people involved in the conversation and there are two voice streams, then either it's an involving conversation or an argument. If there is sound of laughter then it's a very lively conversation. If the voices are high and laughter is absent then there is high chance it's an argument. If only one person is talking then the conversation is either boring or serious. It's difficult to distinguish between a serious conversation as in the case of an employee and his superior or a very boring conversation since in both cases the conversation is one sided.

## **Visualization:**

### **Visualizing the usage of devices**

We are surrounded by a variety of gadgets and they have ceased to be just devices but have become part of our every day life and they have a strong impact on our behavior. The ring of a cell phone calls for an immediate reaction from its user. Its not surprising to see more than one person checking his phone when ever there is a alert. In the near future most devices would have inbuilt technology like Bluetooth which would make it easy for the system to identify the device.

The list of devices that the wall would react to are cellphones, laptops, mp3 players, cameras, pda. Users



were asked to rate these devices according to the order of their importance and the following hierarchy was developed.

Cellphones  
Laptop  
PDA  
MP3 player  
Camera

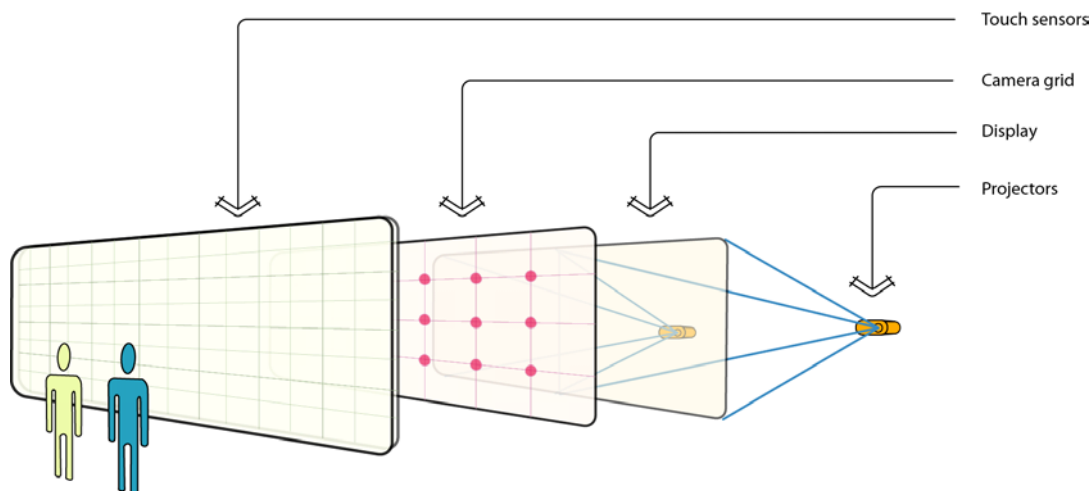
This hierarchy was developed to identify which of the visualizations needed to be visually powerful. The visualization is based on the way the device operates, in the case of a cell phone, it is a transmitting device and the way it communicates with the tower is also very unique. The cell phone switches its frequency every now and then when its is connected. The user talks into the device and this get converted into a digital signal and gets transmitted. In the case of a laptop data transfer happens in terms of high speed data packets but in the case of cell phones it is continuous transfer.

Once the nature of conversation is identified then each person is assigned as wave which changes amplitude based on user voice. If the conversation is relaxed it results in a smooth curve else the wave sequence is of high amplitude and high frequency ( closely spaced). Color also is used to signify the nature of conversation, blue is used to signify calm and involving conversation and on the other extreme if its an argument then the wave turns red in color.

**Visualization for Climate:**

The basic unit of the system the square, the unit is programmed to react to the changes in the environment. The inputs to this system are changes in environmental variables like temperature, rain, wind and precipitation. Climate is a combination of these variables. Instead of developing simulations for each climate a better approach is to design the reactions to the changes so that the result is totally unpredictable and unplanned.

so finally The whole system is conceived to be an interconnected system of squares. The units are bonded to each other through an elastic link. Each unit has a randomly generated value (unique identity) based on which it reacts differently to the climatic variables. Thus any change in one unit would bring about a change in the grid. Each unit has a randomly generated value which changes its reaction to the changes in the environment. The changes in the environment effects the units and also their connections. If the climate is very sunny then the units become very light and the bonds weaken and if there is breeze, they may fly off and a new set of squares develop in their place.



### Designing the wall:

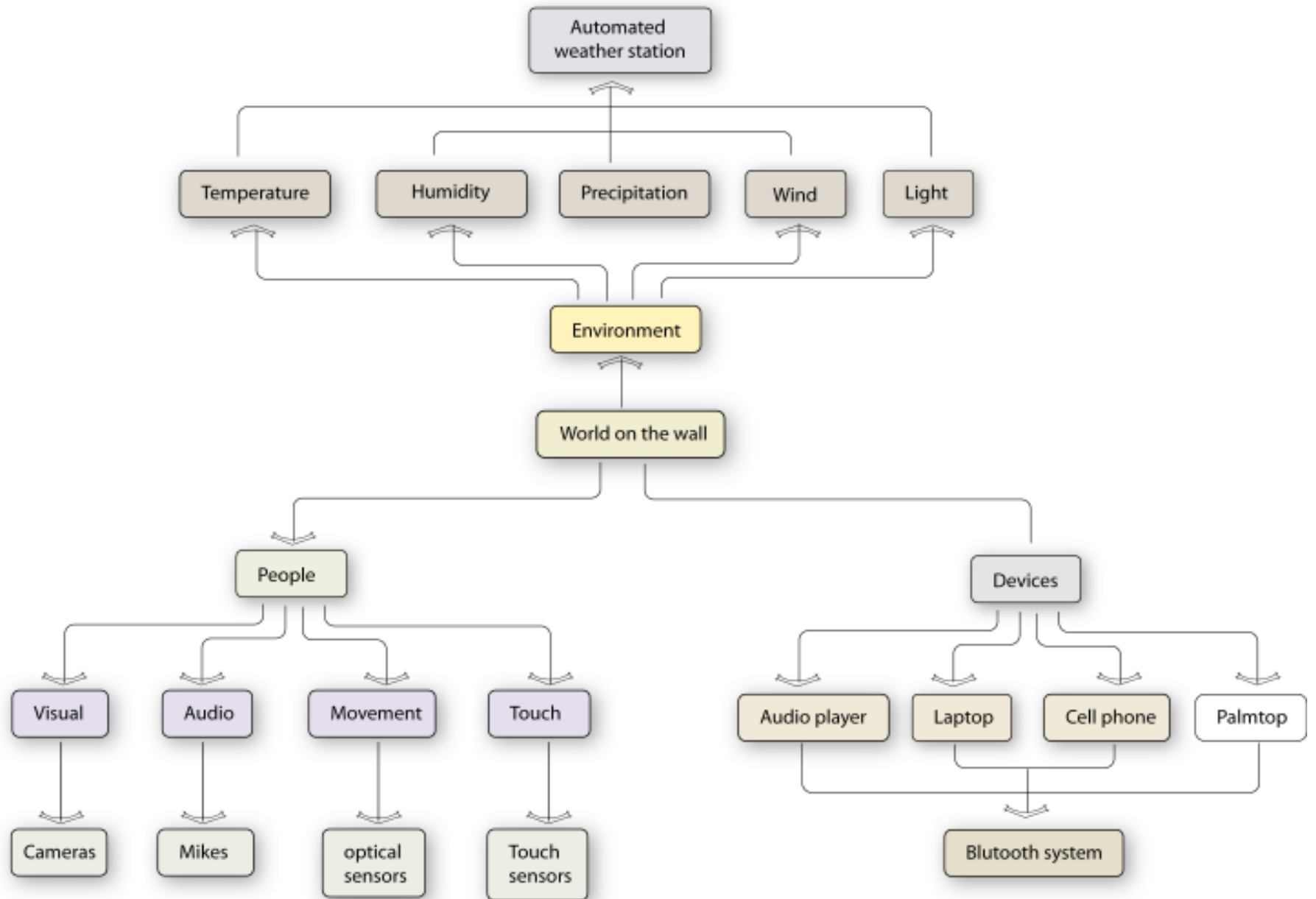
A network diagram was generated of all the variable effecting the wall, then various sensors were identified based on the desirable input.

### Environmental variables:

The environmental variables are temperature, sunlight, precipitation, wind and humidity. An automated weather unit it to be installed outside the office and connected to the main system. The system thus generates the variables based on the environmental inputs. The unit identified to be installed was the Vantage Pro station built by Pro data weather systems UK.

### Visual Input:

The usual approach for all video conferencing system is to use a single camera and is usually mounted on top of the display system. The issues arising with such a set up are problem with gaze and image distortion when subject is close. People have solved these problems by keeping the camera behind the screen and keeping the screen at an angle so that it allows for both projection



and capture at the same time. The projector in this case has to be kept in front of the screen ( which would interfere with the people standing in front of the wall )The other approach is to use a screen which turns opaque and transparent matching with the frame rate of the camera. Both these approaches were turned down because of the cost involved and the loss of image quality.

**The problems faced** in deciding a visual capture system were

To use a camera placement which would solve the problems with gaze

Problems of capturing a large area 3000 x 2100 mm.

To have a distortion free image (optical problem arising with using a fish eye lens)

The proposed solution was to use a grid made up of inexpensive cams whose feed would be then stitched to form the final image. The grid dimension was worked out after working out the coverage and focus range of the cameras. The setup was tested by connecting two usb cameras to the computer and then combining their feed to form a composite image.

**Problems identified after testing:**

The cameras need to be of same specification since any change in the specs of the lens made it difficult to combine the frames. ( two zoom levels)

The camera settings ( brightness, contrast and color ) need to be corrected to get a uniform final output.

**Audio input/ output:**

Video conferencing systems normally have a stereo audio setup. The problem identified with the existing system was that it was difficult to locate the source from the stereo output (sound output didn't correspond to the location of the user on the screen). Another problem which was raised by many researchers was that it was a natural tendency for users in actual group interaction to move closer to a subject if they wanted to have a private conversation. In the case of normal video conferencing systems moving closer to the wall wouldn't help. A solution to this problem was worked out by placing the microphones along a grid with the cameras. This allowed for precisely isolating conversation zones. If the user wanted to have a private conversation he has to move closer to the wall by which the system isolates that stream and plays it on the corresponding speakers on the wall at the other end. In the course of normal usage to save bandwidth a single audio stream is sent, so according to the need separate audio streams are sent.

**Problems:** Problems foreseen with such a system would be ones related to echo and background noise.

**System functioning:**

The system takes a picture early during the early hours when there are no users in front of the wall and sends it to the remote wall. The system then compares all the shots it takes later and identifies the changes in the frame ( identifies the users in front of it) it then pixilates those areas using the algorithm developed and sends it across. It also sends the other variables which get rendered and layered along with the earlier visualization. Thus system allows for optimum usage of bandwidth.

### System Keeping track:

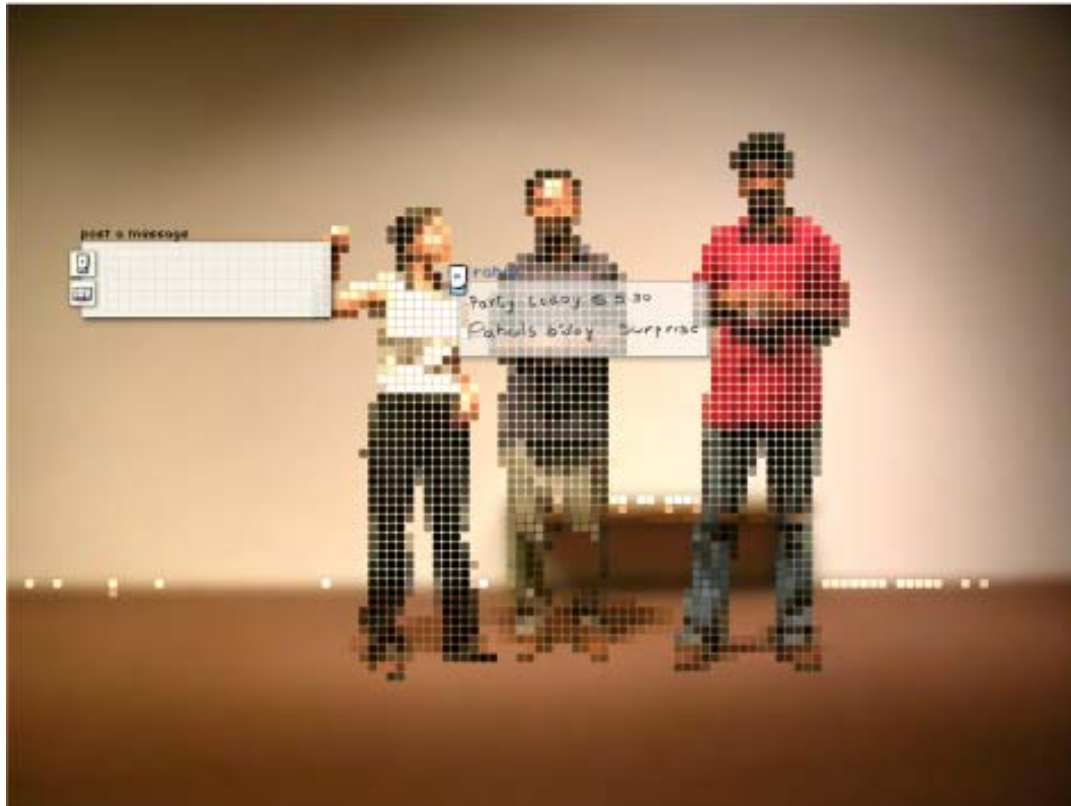
When people start interacting with each other using the world on the wall, there is a need to keep track of who's interacting with whom. The reason for this is that the wall offers a pixelated image of the users to protect their privacy and provide anonymity, thus it would be impossible for them to identify each other the next time they are logged on to the wall. Thus the user must be prompted that it is the same person that he had been interacting with earlier when both of them are logged on to the wall.

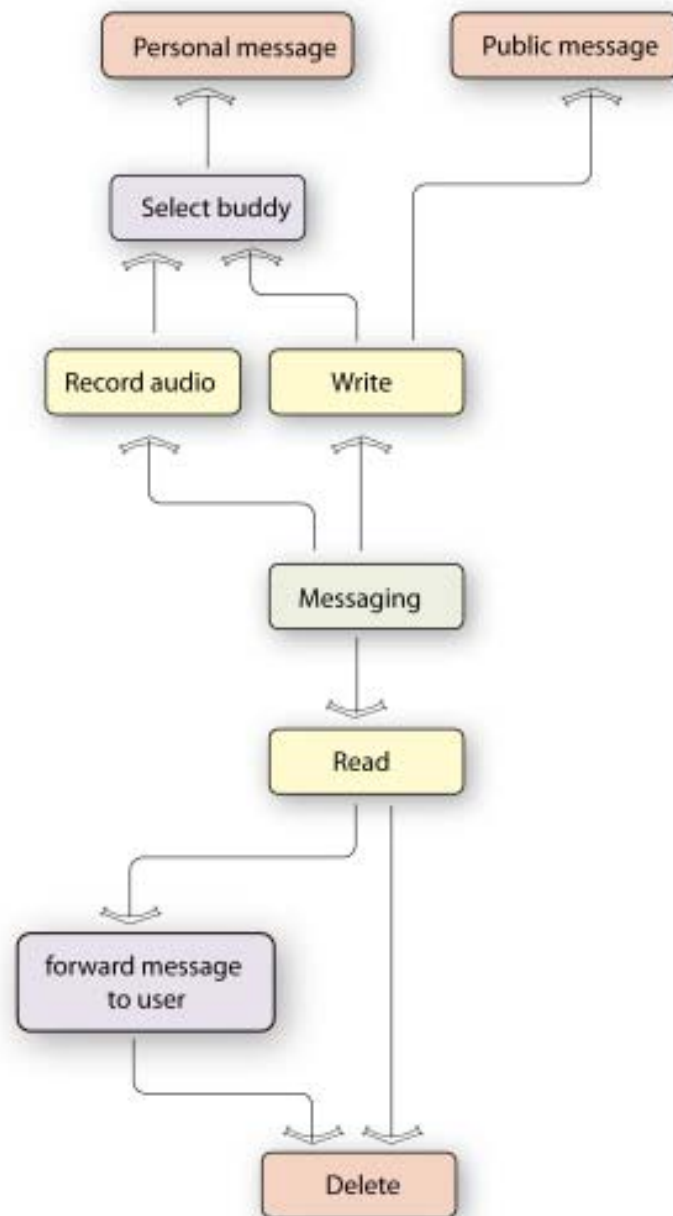
It's an established practice in all the offices to wear identity cards. If id card are embedded with a radio frequency identification tag then the system can identify people by scanning when ever a user is near the world on the wall. Each RFID tag has a unique id which allows for the system to keep track of users.

(<http://electronics.howstuffworks.com/smart-label.htm> details of RFID tags)

### Messaging:

The wall provides anonymity to the user, but for building relationships you need to have a continued interaction which is only possible if there is a system of identifying each other the next time they come in front of the wall and a means to leave messages. The parallels of this could be seen in the case of internet chat, where users are identified by their chat names. Thus a system was developed for users to identify their friends and leave messages. The system was made as intuitive as possible. The user can leave either voice or text messages. The messages could be either personal or public messages. The user activates the message system by touching the wall, he writes the message on the touch sensi-





tive area of the wall. The user can choose whom to send the message to from his buddy list or else it becomes a public message.

When ever the user touches the wall the messaging window opens out, the user can scribble a message on the surface which then gets converted to vectors, The user then can decide to post it as a public message or he can select a buddy from his buddy list and post the message to him. When the buddy comes in front of the wall an animated icon would inform him of the personal message. The user can also select audio button to leave a personal audio message, he then records the audio message and selects the buddy and then posts the message.

The first version of the wall functioned as a graffiti wall, where public messages were are always visible. After user testing it was found that the messages created a lot of visual disturbance so it was decided to show messages as floating icons which would open up when users clicked on them. A separate message window was provided for the messages since just having the message on the screen made it difficult since it in some instances it just merged with the background.

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