Our Team Name
Fall Quarter

1 Executive Summary

(To hide these blue remarks, set `commentson` *in me310report.tex)*

Suggested length of this section: 2-2.5 pages including figure(s). This the most important section to edit carefully. It should stand alone. Assume it is the *only* section that your corporate liaison's boss will read.

- Introduce the reader to what your project is about.
- Say something brief about the design teams (local and global).
- Motivate the current project direction. The motivation is based on findings from user and expert interviews, benchmarking, CEP and CFP tests, etc. What interesting findings or insights do you have?
- **What you did** is less important than **what you learned**.
- Make sure your current "Point of View" comes across. The person who reads only the Executive Summary should still have an idea who your User is.
- Include one or two images that capture the gist of your design. For Fall, we're probably talking about pictures of a proposal or vision. However, it's possible that something from your CFP, CEP is useful. If so, by all means use it if it!

The remainder of this section is taken from [**?**], a pretty good Fall document, done in Latex.

Example text

Engineers must work with distributed teammates around the world. More than ever, designers are tackling all stages of design with remote coworkers whom they may never actually meet face to face. Functioning in this distributed environment can be very challenging both technically and socially. While there are many great tools for managing data and capturing concepts, sharing the output of these tools between distant teammates requires thoughtful planning and continued effort to include distant coworkers during the meeting. Also, distributed team members often feel a sense of isolation - studies have shown that people will collaborate more with people in the same room than with their distributed coworkers who are calling in [?]. Developing a way to level the playing field for distributed designers is essential for ever achieving effective distributed design.

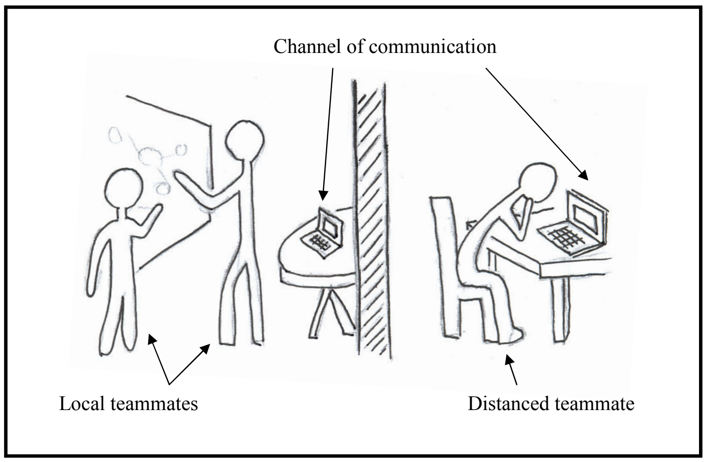

Figure 1.1: Common result of destributed design meetings

Autodesk has approached our team of 3 engineering students at Stanford University and 3 engineering students at Pontificia Universidad Javeriana to tackle this issue of how to get engineers to collaborate better. To gain an understanding of what makes great collaboration, we have surveyed existing collaboration technology, talked with designers, and run scenarios for different collaboration environments. We focused on solutions for the early stages of the design process between small, distributed teams.

After researching a plethora of communication devices for sharing audio, displaying video and sharing drawings, we realized that the critical issue was not how to input drawings or video. The more pressing issues are how designers share the output of the tools and how to capture records of the information that is created. During the brainstorming phase, where ideas are generated quickly and randomly, finding a way to record a meaningful and accessible archive of concepts is especially difficult with existing collaboration tools.

Another important component of obtaining improved group collaboration is getting people to work together as a cohesive group, be it a distributed team or not. How do you deal with the coworker who keeps dominating the conversation? How do you get that quiet person to be more involved? No one is responding to my idea, don't they like it? The team has hypothesized that applying one of the key tenants of improvisational acting could assist with these social frustrations - have a moderator. Dialogue is critical to successful brainstorming, and can potentially be facilitated by objective feedback from a third person observer.

We also tested the ability of uncrowded channels to pass information without disturbing the flow of conversation. By prototyping a tactile feedback system, we found that it enabled a non-intrusive way to get someone's attention, and more importantly created a sensation of proximity with distributed teammates.

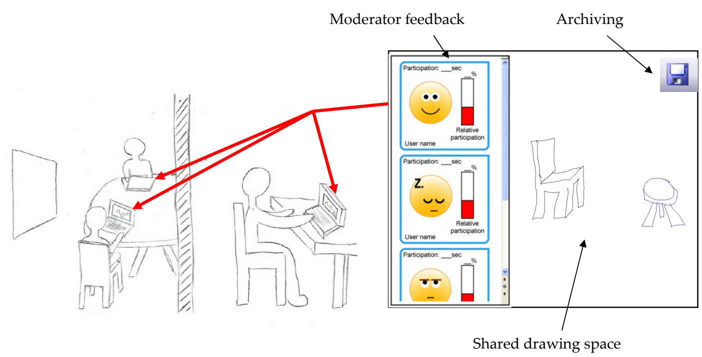

Figure 1.2: This is my new figure caption.

A vision for the final product is to better enable dialogue by displaying explicit teammate feedback and participation level visible to the team. Imagine knowing when someone wasn't paying attention, or that your teammate thought you were talking too much, or that everyone really thinks you're idea is pretty cool. All of this could be displayed without saying anything. Aside from simply providing a platform to share information, the system will monitor the quantity of inputs and determine individual participation level, and also offer the opportunity for direct feedback. The objective is to provide a real-time answer to a common wonder - what are my teammates really thinking?

Latex tips:

- These remarks in blue disappear if you select \commentson{remark} in me310report.tex
- Some teams will find the default report cover sheet too plain and will want to change fonts and layout, etc. This is a tedious in Latex. Use Powerpoint or Photoshop or other program to make a nice outer cover which you can pre-pend to the PDF file from Latex.
- References are linked using the“cite” command. The template is currently set up to use a bibliography style sheet “plainurl310.bst”, which is close to the style used by IEEE and other journals with citation numbers in square brackets (e.g., [1]) and printed alphabetically in the Bibliography section. The modifications provide for printing a URL (if there is one) for each reference in a plain format. Numerous other bibliography styles are available, although many do not work with URLs.

Contents

List of Figures

Glossary

3d audio technology Simulation that creates the illusion of sound sources placed anywhere in 3 dimensional space, including behind, above or below the listener.

action-event control Process where a user action creates an physical event.

API Application Programming Interface.

array of microphones Microphones linked together to expand the effective coverage area.

Ausim 3D audio hardware company.

Automatic beam steering Signal processing technique to narrow the microphone coverage area. Used to pick out a speaker and suppress background noise coming from directions other than that of the speaker.

Benchmarking A process of researching and observing to understand the state of the art for a given field or topic.

Brainstorming A process by which groups of people generate ideas

Brainwaves A common term that refers to post-synaptic potentials measured from many neurons in the brain

CDR Center for Design Research at Stanford University

CFP Otherwise known as a Critical Function Prototype, this is a prototype built to test a concept that is critical to addressing the problem statement.

Client Computer program that accesses a server.

Client-server paradigm A computing architecture which separates the client from a server over a computer network.

Crowded channel A communication channel that is clogged with information.

CVE Acronym for Collaborative Virtual Environment. This is a virtual environment that support more than one user at the same time.

Dark Horse An idea that is unlike the others preceding it, an outlier.

It's a sign of a successful team that the glossary becomes extensive. Define any non-obvious or invented terms. For example, if you reference something by an acronym, that might be a glossary term. Teams also coin terms to describe design features. Define such terms here. Don't define obvious stuff (axle, keyboard).

See comments in me310report.tex if you want to generate a glossary semi-automatically from tagged keywords.

2 Context

Suggested length: half a page to a page each for the Need Statement and Problem Statement (plus figures, if any). Another page or two for the design team.

The Context provides background and motivation for your project. It is an enlarged version of the brief context in your Executive Summary.

- Who came to you with a proposed project area? Who is the corporate partner and what is their context?
- What background or context set the stage for your Needfinding and Benchmarking, activities?

2.1 Need Statement

This section is the high-level result of your user need-finding. It provides the background for the "Point of View" or hypothesis that guides your ongoing work.

- Who wants or needs your product? Why do they want it? Or, what need does the product area address?
- What evidence do you have to substantiate the need? Use citations or other evidence you've gathered.

The remaining text is taken from [**?**].

The design world has changed dramatically in the last decade. The widespread advancement and usage of digital prototyping tools has made it simpler and faster to realize new ideas. At the same time, globalization is requiring designers from remote locations to combine their ideas and make design decisions.

With the advancement of computational power and communication speed, digital prototyping tools have made it possible to transmit complex drawings around the world. Most digital tools that promote remote collaboration target the idea-to-conception stage of development. The early ideation stages of engineering design, however, are still more effective when discussed locally. The problems of effective communication and effective decision-making in this setting are still largely unsolved. Internet tools setup the virtual meeting space, yet communication is still not as effective as meeting in the same room. Often meeting participants cannot truly work together as they do face-to-face.

Wouldn't it be perfect to have a new tool that focused on the interaction aspects of remote collaboration? A tool that made communication effortless, as if the participants were in the same room. Such a tool could increase the ideation potential of remote meetings and make remote brainstorming a reality.

2.2 Problem Statement

Here you get more specific about the particular problem that your design vision is addressing. The remaining text is again taken from [**?**],

In order to facilitate remote collaboration in the early design stage, we first break down the problem into the following three areas.

- Social Dynamics
- Communication tools
- Idea storage and decision making

Early ideation is a very social process and requires effective interperson communication. Current teleconferencing tools lack in recreating the level of social dynamics present in face-to-face communication.

Communication tools are a means with which we transmit ideas to each other. This could be either through speaking, body language, or drawing. The early ideation stage requires a rapid exchange of ideas between all participants in a meeting. How can we utilize communication tools effectively to make such a dialog easier?

Finally, the brainstorming stage presents a plethora of ideas that need to be archived and categorized for effective decision making. How can we make it easier for meeting participants to save their ideas and retrieve them later? How can information be viewed to facilitate decision making?

2.3 Corporate partner: Autodesk

The corporate partner for this project is Autodesk Corp. Since 1982, Autodesk has delivered 2D and 3D visualization tools for clients in manufacturing and design. Well known products include the drafting program AutoCAD , digital prototyping software Inventor, and 3D modeler Maya. The company focuses on enhancing the design process by allowing the customer to experience their design through software. Increasingly, Autodesk is interested in tools for portable computing (e.g. tablets) and for integrated solutions that allow design, video collaboration, data management, etc.

Add a bit more about the corporate partner and their context, perhaps using the information you started to obtain in the Business Canvas exercise, as introduced in class. A couple of good examples can be found in the 2012 Spring documents from Electric Mobility Norway [**?**] and Symbioseé [**?**].

Corporate Liaisons

Say who the liaisions are and give their contact information.

2.4 The Design Team

See other recent reports for other ways of introducing the team. To the extent that the characteristics of the team influence the project direction, this is of interest to the reader.

Team *Papier Mâchè*, was assembled from individuals with a diversity of thinking preferences, interests and backgrounds. There is some evidence that such diversity enhances team creativity [**?**] [**?**], even if it creates additional challenges for team management.

Larry Leifer
Status: Professor, Mechanical Engineering
Contact: leifer@cdr.stanford.edu
Skills: deisgn, mechatronics, welding, prototyping
Computing: Solid Works, Matlab, basic C programming, Forth

Born in Santa Barbara I remain a surfer at heart. My research is focused on instrumenting, understanding, supporting, and improving design practice through the development of design theory. BS in in Engineering Science, MS in Product Design, PhD in Biomedical Engineering, all from Stanford. Founder of the Center for Design Research and one of the founding faculty members of the Hasso Plattner Design Institute at Stanford (aka the d.school).

Favorite activities include surfing, hunting and wayfaring, and frequent trips to Lucerne, Switzerland.

Mark Cutkosky
Status: M.E. Graduate Student
Contact: cutkosky@stanford.edu
Skills: woodworking, masonry, soldering, Lasercamm
Computing: Matlab, C, Python, Perl, Inkscape, basic Unix

Born and raised in Pittsburgh PA, I worked at ALCOA as a machine designer before getting my Ph.D. from Carnegie Mellon University in Robotics. My research applies analyses, simulations, and experiments to the design and control of bio-inspired robots, robotic hands, tactile sen-

sors, and devices for human/computer interaction. In manufacturing, my work focuses on multi-material rapid prototyping methods.
My lab: http://bdml.stanford.edu

George Toye
Status: Consulting Professor, Mechanical Engineering
Contact: deputy@me310.stanford.edu
Skills: machining, welding, foreign languages
Computing: Solid Works, Assembler, Eagle, various computer languages

Originally from Taiwan, I grew up in Montreal and San Francisco. BSME from U.C. Berkeley and Ph.D. from Stanford in M.E. I have also worked in various Bay Area consulting and high technology startup firms. My expertise includes mechatronics (I have sometimes taught ME218) and Unix/Linux server management. My own company is http://www.withinc.com/.

Coach

Say who your team's coaches are and give some basic information and contact information.

Experiments with tables in Latex

Here is a centered tabular form that is 3/5 of the current text width and has a horizontal line but no vertical lines:

a label spanning 3 merged cells			label 4
item 1a	item 2a	item 3a	item 4a
item 1b	item 2c	item 3c	item 4c

For anything more complicated than the examples in this section, it may be easiest to do the table in MS Word or OpenOffice, create a pdf and include the pdf in a table environment. Because pdf files have scalable fonts, the print resolution will be good. For example, Table **??** is taken from an Audi fall document [**?**] done in MS Word and pasted as PDF into Latex. Notice that the fonts are scalable if you zoom in.

Requirement	Metrics	Rationale
Relevant controls should be within reach of the driver and front passenger	Users must be able to reach controls without having to lean.	In order to allow for minimal distraction while driving, user should not need to shift positions.
Controls should be comfortable to use.	Users will report no feelings of awkwardness or fatigue from trying use the controls. Buttons will push down with a reasonable amount of force.	Users will not want to use a system that is uncomfortable.
System interface should be distributed throughout the vehicle.	Controls will be spread out over the cockpit.	When all the functions are combined into one control, the system becomes too complicated to use, resulting in a steep learning curve.
System will retain the Audi "genes"	Integration of the interface will allow previous Audi drivers feel like they are just in another Audi	Users like consistency. A vehicle brand should be dependable, in-line with its current look, feel, and overall theme.

Table 2.1: Physical Requirements from [**?**], used here just to illustrate how PDF can be pasted in as a table

3 Design Development

For fall, the development chapter focuses on benchmarking, need-finding, persona development and the first critical function and critical experience prototypes. For later quarters, many of these details will go to an appendix, with just a summary of the main findings and insights. Even in fall, the focus should be on findings and lessons learned.

- Focus on results (e.g., key findings, insights, lessons learned), not team activities ("We brainstormed extensively and eventually settled on two alternative concepts.")
- Use lots of images, and not just photographs: diagrams, schematics, flow charts, CAD renderings, etc. are often much more informative than a photo. In any case, use labels pointing to the features you want the reader to appreciate. Also, do refer to all of your figures explicitly in the text (*As shown in figure xx, ...*).
- Lengthy details (e.g. detailed results of technical benchmarking) should go in an Appendix section, with an explicit forward reference from this section. In winter and spring, much of this material will go to an appendix.
- Be professional: it's essential to properly cite sources of information and provide credits for any images you are using that you did not generate yourselves.
- Don't refrain from describing ideas that were briefly pursued and dropped. Explain why they were abandoned. In other circumstances they might be worth picking up again.
- You can use tools such as Pugh concept selection, function-structure diagrams and design decomposition [**?**, **?**, **?**] to organize and clarify your design process. Many web-based tools also exist for diagramming relationships (e.g. http://vue.tufts.edu). A nice side-effect is that such diagrams help with documentation.

The remaining text in this section contains excerpts from the Autodesk 2007-08 Fall document [?] and some additional explanatory examples.

We drew from our diverse individual experiences to redefine the problem as we learned more about existing collaborative tools and practices. Throughout the design development process, shown in figure **??**, we balanced pushing forward with our current ideas while looking for new directions.

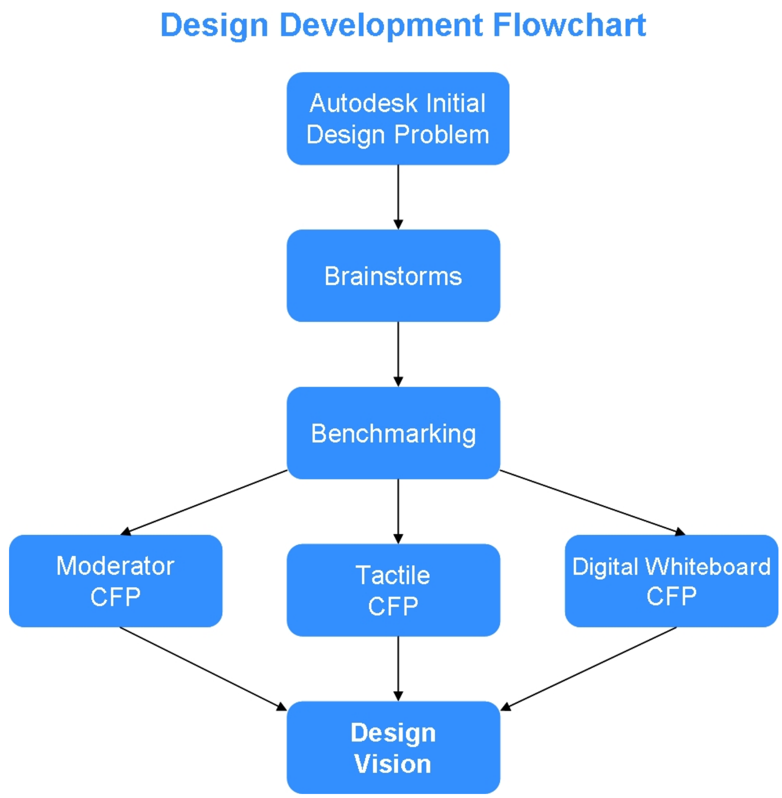

Figure 3.1: The design team's development process.

3.1 Brainstorming

Our experience in brainstorming was unique in that we were observing and studying our own behavior while exploring solutions. We were constantly studying our own triumphs and shortcomings in the hopes of gaining insight into team dynamics. The results of our multiple brainstorms throughout the fall quarter can be into categorized the following categories:

Communication

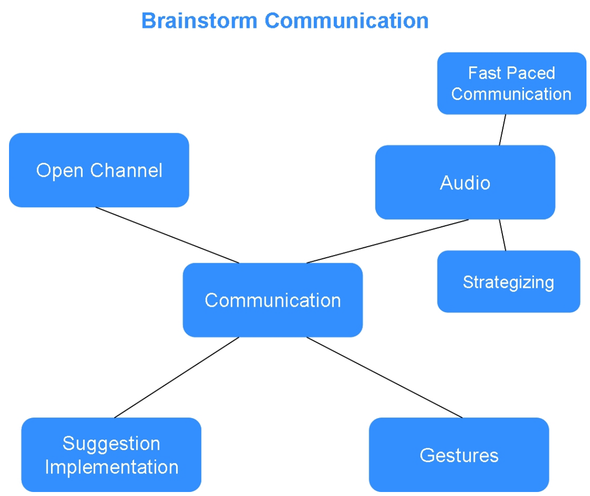

Figure 3.2: Key components of communication in design meetings

- Open channels
  - Audio and video channels are often inundated with information, even if they are not the most effective means to transmit a piece of information. The team learned that messages are most clearly conveyed when they are free from interference.
- Integrate suggestions quickly
  - People can build onto other's ideas immediately, and rapidly change the direction of the conversation.
- **Verbal communication is the most flexible**
  - The team learned from their experience playing cutting-edge multi-player videogames that verbal communication was the most relied upon medium during fast and slow paced activities. It's versatility and low-bandwidth warranted future attention.
- Gesture
  - Gesture is frequently used when explaining an idea. Often, the drawings produced do not look at all like the concept being developed, but the act of drawing in and of itself can be like a gesture, showing how something will work, or where it will be placed, and so forth.

The rest of this subsection is omitted for brevity

Some key realizations from the brainstorming phase were that social factors and communication shortcomings had alot of opportunity for development. We decided to give special attention to social benchmarking in addition to our technological research.

3.2 User benchmarking and need-finding

In this section briefly describe activities undertaken to come to an understanding of users or potential users and their needs. An important part of this section is the development of personas.

Personas development

Describe the personas, what findings are incorporated in them, and what insights they provide for the design. Ideally include some images of your personas, like "Kevin" in figure **??** from the 2011 Lockheed project [**?**].

3.3 Business Benchmarking

A recent element in me310-global thinking process is to be explicitly aware of the client's business model. The motivation for this new element is our growing awareness that coming up with the next "big-idea" may be the easy part of our quest. The harder part may be gaining acceptance of our breakthrough innovation within the organization. Please be aware that the canvas can be re-organized to suit your situation.

A starting point could be the "Business Canvas Model" introduced in class (figure **??**) with reference to [**?**] for more background information.

Bencharking the corporate partner's business model and goals is part of benchmarking, and can be covered in a section in this design development chapter. Some examples of recent ME310 documents with fairly extensive business benchmarking include the 2012 Spring documents from Electric Mobility Norway [**?**] and Symbioseé [**?**].

3.4 Technology benchmarking

The team's research and benchmarking efforts were focused on three major categories: human-machine interfaces and input devices, social dynamics, and communication. The methods the team utilized to research items in these

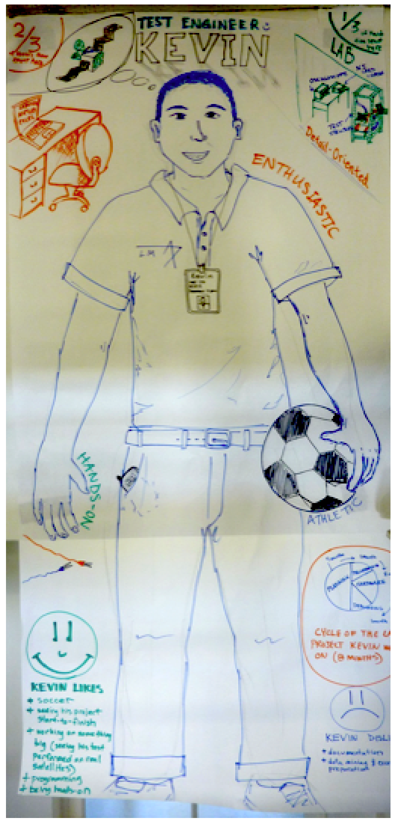

Figure 3.3: A persona for a satellite testing project (from [**?**])

three main categories included trying out hardware, drawing on previous experience, participating in improv exercises, researching existing solutions, and speaking to experts from design, neuroscience, and computer science.

The Nintendo Wii - Accelerometer-based input)

The team investigated some unconventional means for data input. Gesture-based input devices like the Nintendo Wii controller offer the possibility of an intuitive, and compelling way to interact with someone at distance via digital means. For navigating through Windows or other applications, the team found the Wii to be more challenging than a conventional mouse. Accelerometers are adept at capturing large motions rather than precision pointing and would need to be utilized as such. Potential applications could be for interfacing with avatars or tactile feedback systems. The Wii controller could be used

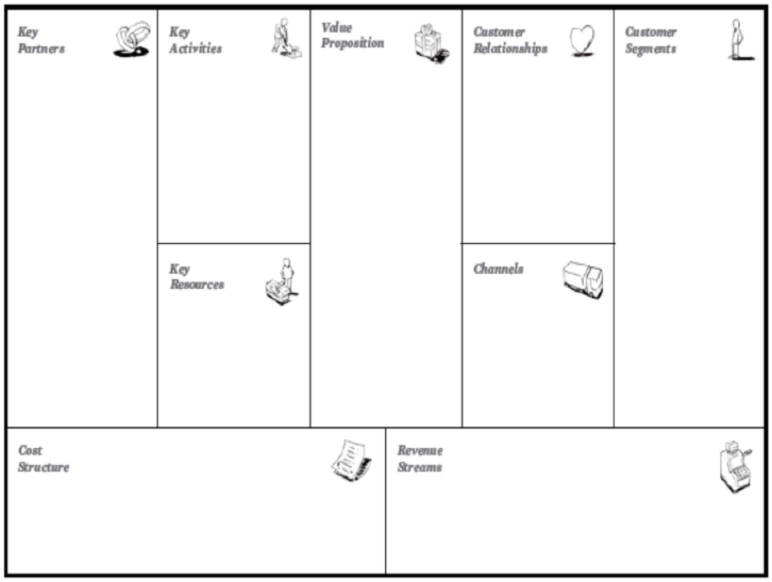

Figure 3.4: Business Canvas (from [?]).

as a gesture-based communication device to control a personal avatar or send and receive tactile messages.

Key lessons learned

- Accelerometer based input devices could be used in gesture-based or tactile communication, but do not fare well in precision pointing.
- Gesture-based interfaces generate excitement. People want to use input devices that respond to gesture.

CyberGlove ®

The rest of this subsection is omitted for brevity

EEG and Participation Monitor

The team met with Alicia Warlick, a researcher in the Stanford Neuroscience Department, and her research in monitoring brainwaves. We discussed the possibility of monitoring whether meeting participants were actively paying attention by using an EEG. This is a method for measuring the activity level of the brain. There is opportunity to use this as a metric for testing our final

Figure 3.5: People playing Wii Sports on the the Nintendo Wii. There should be a citation to the URL this photo came from.

product, or potentially in the product itself as a means to collect data on user participation level.

Key lesson learned

- Electrodes could be placed on the users forehead and scalp (as in Fig. **??**) to measure EEG readings, which conveys information about whether someone is engaged in what they are doing, or if they are withdrawn.

The rest of this subsection is omitted for brevity

Figure 3.6: CyberGlove gesture-based input device. There should be a citation to the URL this photo came from.

Figure 3.7: Example of the first available wireless EEG tool, made by IMEC. There should be a citation to the URL this photo came from.

3.5 Critical Function and Critical Experience Prototypes (CFP/CEP)

The initial benchmarking phase lead the team to realize that there were three major challenges to solve: bridging the proximity gap, moderating brainstorming, and conveying and recording ideas. The team decided to tackle all three of these major challenges and designed four CFPs in an attempt to solve, or at least start answering some of, the questions these challenges brought up.

Tactile CFP

The team wanted to come up with a creative solution that would enhance distance communication. Although we identified software having an important role in our solution, we wanted to try to design something physical. We had to answer these questions that were raised after the benchmarking process:

- How can we simulate proximity for remote meetings?
- How can we implement action-event control?
- What senses can we stimulate that aren't normally used?
- What is a low bandwidth solution?

The team decided that building a tactile messaging system would solve all four of the aforementioned questions. Tactile messages could replace common interpersonal interaction found in same room meetings. It is normal to welcome each other with a handshake, make eye contact throughout a meeting, smile at each other, and give high-fives to congratulate others. These occurrences are all absent from distance meetings. A tactile message corresponding to each of these gestures would allow users similar opportunity to communicate as if they were sharing the same physical meeting room.

The team learned that immersive activities like videogames take advantage of action-event control to offer users a seamless means to interact with their environment. A tactile message could quickly be sent over an open channel and pressing the on button would instantly message the recipient.

Out of the five senses (sight, hearing, taste, touch, and smell), sight and hearing are the most relied upon during meetings. The team considered possibilities in taste and smell messaging but continued with touch, since delivery of tactile messaging was much more straightforward. Since conventional distance meetings only send and receive auditory and visual information, tactile messages would be distinct and easy to identify. The team believed that tactile messages (high, low, or off) would be low bandwidth.

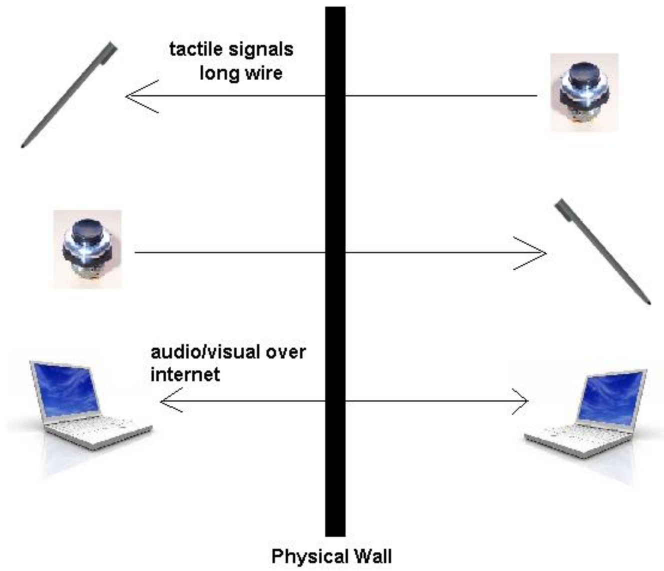

Figure 3.8: The team's whiteboard during a brainstorm session

The team wanted to test the effectiveness of tactile messaging and decided against a TCP/IP protocol that sent messages between Stanford and PUJ. The code to write such a protocol was extant and it was unnecessary to include it in our prototype. The team simplified the setup and created two stations separated by physical barriers (a wall and 50' of distance), to simulate a distance meeting. Each station would have a vibrating tactile device for each seated participant at that station and a high/low button assembly to activate the vibrating tactile device for each participant at the other station. Initially the devices were supposed to operate as "on" or "off." The team decided that having more variability in the operating speeds of the motors would increase the number of different messages that could be sent, and added a high and low voltage button (1.2V and 0.6V).

We were curious to see if effective communication could take place if a distant colleague could see what sketches his distant colleague was drawing. To test this, we used webcams to send live video of what the participants drew on their drawing pads to the other stations.

What is critical about this CFP?

The team identified these questions as critical before testing:

1. Can it create immersion?
2. Does it improve upon existing communication tools?
3. Is it easy to understand?
4. Is it intuitive?
5. When should it be used?

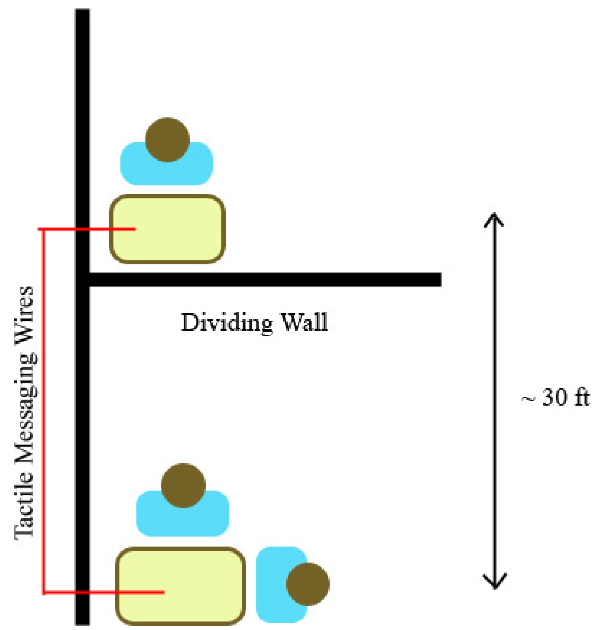

Figure 3.9: The orientation of the two tactile messaging stations.

Tactile Messaging CFP Description

The remaining text in this section contains of excerpts from the Autodesk 2007-08 Fall document [?].

The tactile messaging system was comprised of small Jameco vibrating motors (1.3VDC 8,500 RPM) mounted to ball point pens and wrist patches. A simple switchable voltage supply circuit was created to give each vibrating motor a high (1.2V) and low (0.6V) vibrating speed (??). Each voltage level was buffered with LM324 opamps, and the circuits were implemented on protoboards. The high and low speeds were selected by switches.

Figure 3.10: A simple voltage dividing circuit provided 1.2V (HIGH) and 0.6V (LOW) buffered output voltages for the vibrating motor. Switches triggered the high and low voltages.

(Text omitted for brevity)

Four independent circuits were created to provide messaging to two motors on each side. 90' 16-gauge wire was passed between two stations in the meeting setup shown in **??**. Power supplies provided the 9V signal on each side.

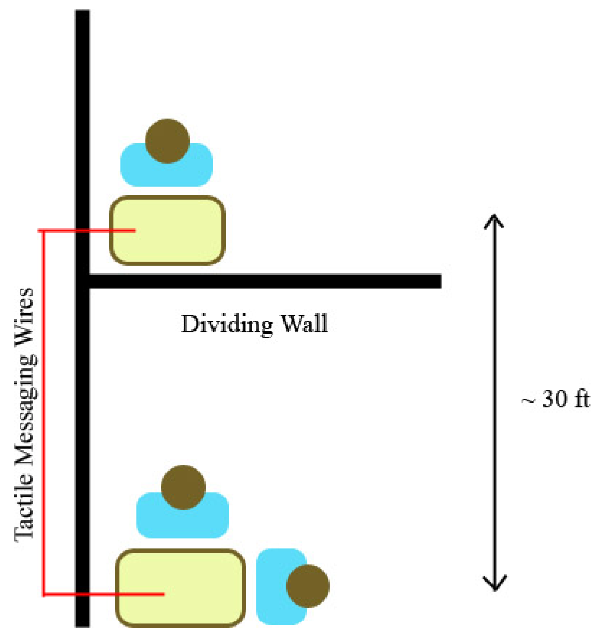

Figure 3.11: Layout of seating during test meeting. Two participants met on one side, with the remote user separated by a wall 50 ft away.

In addition to the tactile hardware, Skype was used for video and audio communication. Video was supplied by standard webcams. We mounted the webcams on risers to show video of a sheet of white paper used as the shared drawing space. We chose to focus the video on ideas rather than facial expressions.

Moderator CFP Description

Layout

The participation moderator was created by using pre-made desktop software applications called widgets. The desktop was set to a white image, with personal spaces for each participant mapped off by a black boundary and labelled with the participant name. In each personal space, a unique Yahoo! Widgets timer was placed. Unique timer's were used to foster a sense of identity- when glancing at the moderator, the team members could instantly recognize their widget rather than look for their name.

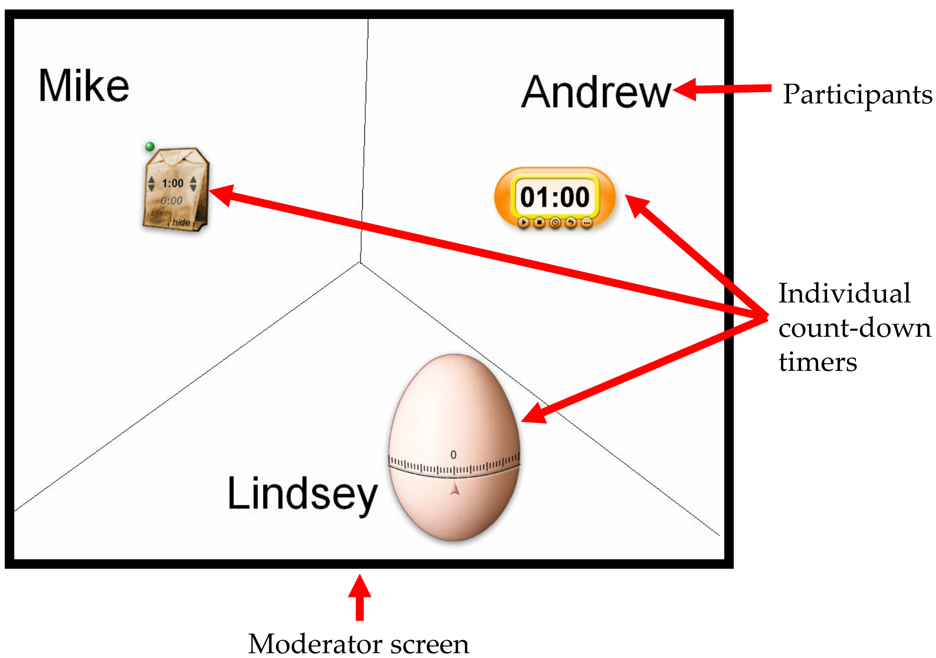

Figure 3.12: View of moderator display

(Text omitted for brevity)

Each was simply a countdown timer with a default starting time, t_s. As they begin counting down, the amount of time remaining is visible. By clicking twice on any widget, it would reset and begin counting down again from t_s. The timers were manually reset by one of the teammates during the meeting whenever someone had an interaction. When any timer runs out, it would sound an alarm, designating that the meeting come to a halt until the non-active team member contributes to the conversation. The hypothesis was that, because the timers were visible to the entire team, each member would consciously make an effort to speak before their timer ran out and that no timer would actually buzz, although the rotation of speakers would greatly increase.

The moderator screen was displayed on a 32" LCD display that was positioned 6' from the center of a table where the group met. The layout is detailed in Figure **??**. No video or audio conferencing was used – all team members were local. The objective of the moderator is to support dialogue in meetings, regardless of whether the members are distributed or not. Audio was recorded of each meeting using Cubase software and an IBM laptop's internal microphone, which was placed in the center of the table so each participant could be heard.

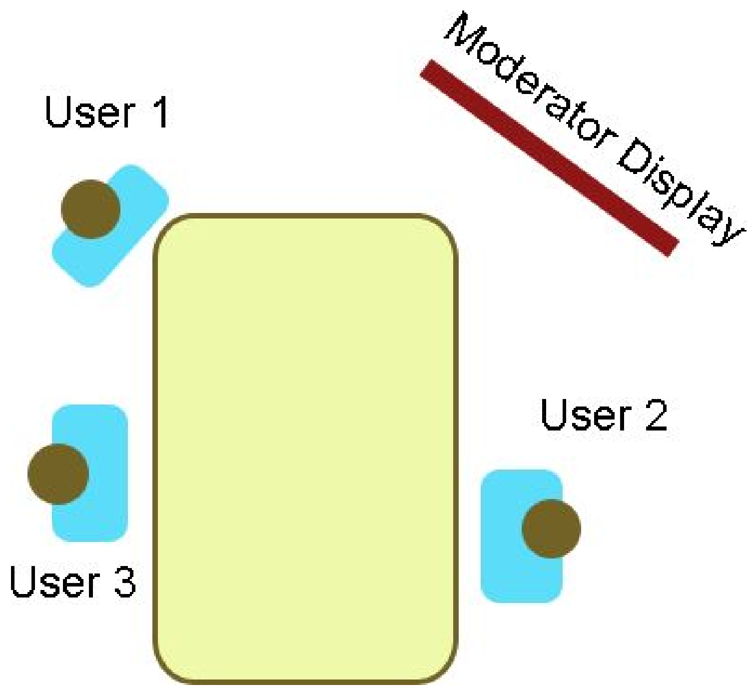

Figure 3.13: Layout of design meeting with moderator prototype

Procedure

Three meetings were run to test the moderator. The subject of each was the same - our team brainstormed potential final products knowing the key lessons learned after our benchmarking. Three meetings were run in succession, each lasting 30 minutes. The intention of this was to eliminate any personal changes between meetings. For example, if Mike has a really bad day before coming in for a second meeting, he may be much less talkative than in the previous meeting, but not as a result of the moderator. The first meeting served as the control, and no moderator was used. The two subsequent meetings used the moderator with t_s at 2 minutes and 1 minute.

The audio files were analyzed manually by playing back the audio recordings for each meeting and recording the length of each comment that every person made. Fifteen minutes of audio during the middle of each meeting was processed. The data are available in Appendix **??**.

CFP Lessons Learned

Ideally there should be something among these findings that reflects back to the personas. Are there particular findings in light of the personas? Do the findings cause you to modify your personas?

Tactile sensation is an effective means of communicating contextual information. The messaging system delivered instant vibration between the two stations, helping preserve the flow of conversation without impeding it. Using the vibrations to alert the other users that you wanted to say something was a good way to make comments at the precise time you intended. The tactile devices were **easy to use** and the participants were encouraged to use them as they saw fit. We noticed that **vibrations were used most frequently to add emphasis** to accompany laughter, to confirm agreement, offer praise for a good idea and to interrupt the speaker. Interruptions consisted of calls for clarification on a point raised or disagreement with an opinion. Interrupting someone who is speaking can cause the speaker to lose his train of thought or become otherwise agitated. We noticed that **users preferred to send low speed vibrations** as a gentle interruption as a first attempt to get the speaker's attention. If the first few low speed vibrations did not stop the speaker, the high speed vibrations could be sent, and these usually registered right away. We observed that users reserved high speed vibrations for urgent or important messages.

The signals were mostly easy to detect, but it was **not always clear what those signals were trying to communicate**. Ambiguous or superfluous signals distracted the receiving user from the meeting and the confused user would ask, "Did you just buzz me?" or "Why did you buzz me?" These confused questions would stall the meeting for everyone until the sender was revealed and was able to explain what they were trying to communicate.

Vibrations, however, were easily detectable despite loud side conversations, a party in a neighboring room, and constant distractions from people walking by. We attribute this to the fact that the tactile channel is uncrowded compared to the audio channel. In a loud environment it is difficult to pick out audio communication from Skype. Visual distractions make it difficult to focus on the laptop monitor. The tactile sensation rarely stimulated in a teleconference, thus making the slightest vibration very noticeable.

We tried two different vibrating interfaces, a vibrating pen and a vibrating wrist patch. The wrist patch was unanimously rejected by the participants because 1) the double stick tape that connected the patch to the user's skin was either too sticky and removed arm hair or not sticky enough after a few uses and would fall off, 2) was tethered to the power supply and restricted movement to the point where the hand with the patch was essentially stationary, 3) vibrations on your wrist are not comfortable, and 4) worry that the patch might give the user an electrical shock. The pen had a practical use, writing, and although the pen was connected to the power supply, the user was not, and the range of motion was adequate enough to write anywhere on the drawing space.

We finally compared the tactile messaging conference to previous experiences with video conferencing and audio conferencing. These results are summarized in Appendix **??**.

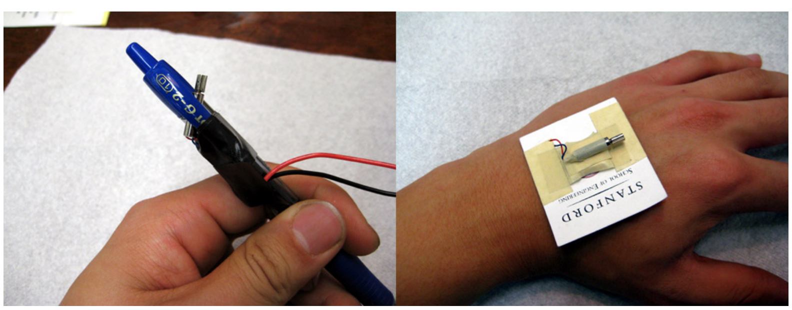

Figure 3.14: The orientation of the two tactile messaging stations. (Note: the wires connecting the patch to power supply are not in this photo)

The tactile messaging critical function prototype was a success in that it definitively answered all the critical questions we asked ourselves before testing.

4 Design Vision

This **Design Description** chapter defines what the design is. But for Fall, it's really your vision or proposal for what you think the design might be by the end of Winter or Spring quarter. So let's call it the **Design Vision** chapter in Fall. It will be a short chapter.

Even so, on the basis of preliminary need-finding, benchmarking and critical function evaluation, you should have some idea of what may be appropriate. Take a point of view and assert it! A CAD rendering, a systems diagram or even a sketch of a concept could help to explain your vision.

If you find yourself adding rationale, or discussing design alternatives or how the vision came about, you are writing text that should be moved into the end of the Development section. This is section is about what the design (or vision) is, not how it came to be.

4.1 Vision

For Winter and Spring, although you now have a design to describe, you probably want to start off your Design Description chapter with a reminder of the overall vision, toward which your current design is an important intermediate step.

Use this section to describe your vision or proposal for what you think the design might be. Ideally you should have a sketch, a diagram or other images to help define it.

4.2 Specifications

In Winter and Spring here is where you describe what your design is.

- Define the subsystems and how they go together.
- Use diagrams, CAD renderings, tables, etc. to make it clear.

- Use flow charts or pseudocode to describe procedures.
- Detailed source code and numerical data should go in an Appendix section or, if really long, on a CD or other electronic format (nobody will wade through the printout).

5 Planning

Teams with global partners face special challenges in terms of organization, project management and planning. It is a truism that organizational burden goes as the square of team size.

To address these issues, we ask each local+global team to prepare a **plan for Winter quarter** to include in this section. You have just accomplished a first, rough critical function prototype (CFP and CEP) and you have given a presentation and written a document that captures the current state of your vision and findings. You have learned who can do what and how much work it really takes. And you are highly motivated to make Winter go more smoothly and to "take control" of your project.

5.1 Deliverables

Define briefly what will be delivered. Of course, this is to the best of your current knowledge – things will change. A short table with some explanatory text could be used here. Your project plan should include the following non-negotiable items and any sub-tasks or intermediate items" that lead up to them. Consult the course calendar for dates and more details.

- Travel: When are you traveling? What is planned for the trip?
- Dark Horse prototype – a 2nd CFP that probes the edge of the design space
- Travel Docs due
- Funky Prototype – an initial system where a potential avenue for the final product is developed
- Functional System Review – your latest and greatest as Winter quarter draws to a close. It should give a clear indication of what to confidently expect in June.
- Winter Design Documents

5.2 Milestones

When are various elements (e.g., rough prototypes, final prototypes) delivered? When are key tests conducted? These are the dates, times, and places where project progress is observable and/or demonstrated. Again, update with planned versus actual dates as the design progresses.

5.3 Distributed Team Management

Explain how your distributed and interdisciplinary team will collaborate, communicate and keep itself on-track with respect to the afore-mentioned deliverables.

5.4 Project Budget

As with any serious proposal, you should include an estimated budget with some specifics about money that has been spent (Fall) and probably will be spent (Winter). Details on vendors can be put in the Appendix. A common mistake is that teams spend too little money until late in the quarter and then spend too much, doing rush jobs and rework.

5.5 Project Time Line

Summarize the projected project time line if it is not already explicit in the project planning representations above.

Use any of the familiar project development representations including lists, Gantt Charts, Pert Charts (Figure **??**), bubble diagrams, tables, etc. In addition, you will almost certainly need a list or table of items that says a bit more about the items and gives an idea who is going to do what.

5.6 Reflections and Goals

This is the one section that you would not find in normal research or engineering proposal. But in the spirit that we're doing this in an academic setting, we want to be sure that we reflect on what we're learning and thinking and where we hope to go with it. The reflections are personal, and can be written diplomatically, for example using the *I like..., I wish...* protocol.

A part of reflective section may include how your team functioned in the fall - explaining how and why your actual design process deviated from what

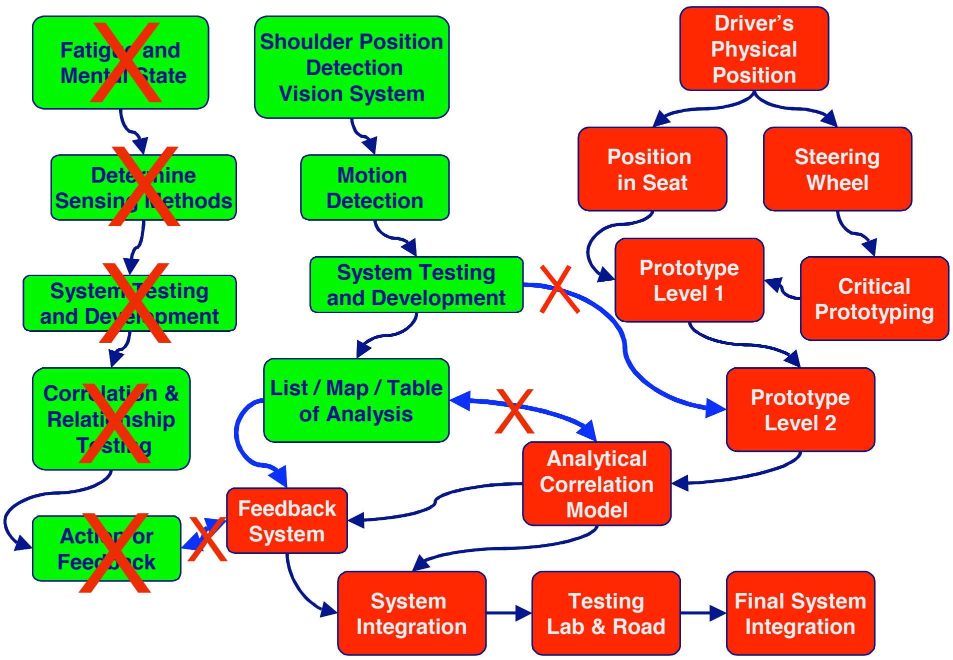

Figure 5.1: In this example from [?], Stanford students collaborated with a group at TMIT, Japan. At the end of the Winter quarter it was decided to abandon one branch of the TMIT effort and to eliminate some of the tight coupling that was originally envisioned.

you originally planned, if relevant. (Time lines and milestones often have the look of having been concocted the night before the report is due.)

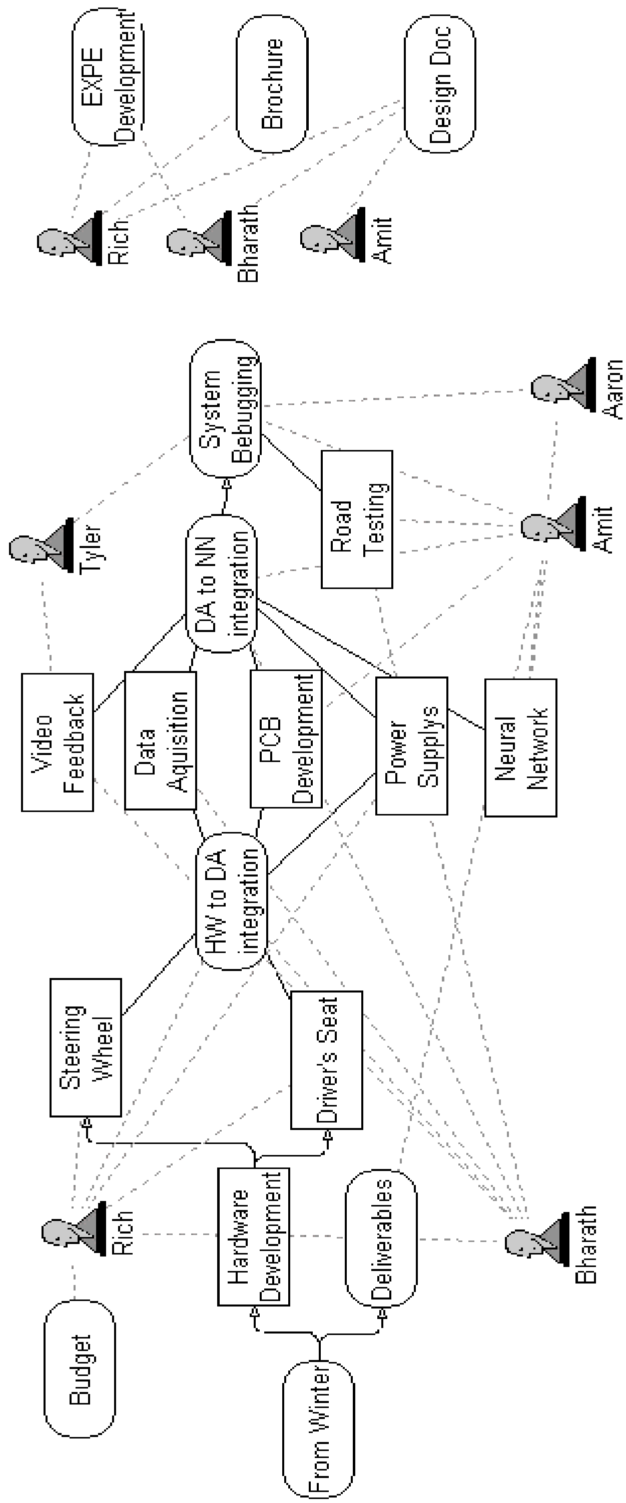

Figure 5.2: An example of taking a large figure and having Latex rotate it 90 degrees to display it in landscape format as a full page figure.

6 Resources

Include lists of human, institutional and vendor resources here with contact information. This is not for direct citations, which go on the Bibliography.

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A Appendices

A.1 Moderator Prototype Data

Adapted from Autodesk Fall 2007-08 [?].

	Length of Contribution (s)				Length of Contribution (s)		
# Contributions	Andrew	Mike	Lindsey	*# Contribu*	Andrew	Mike	Lindsey
Unmoderated				1 min. moderated			
1	40	2	15	*1*	14	12	8
2	50	22	25	*2*	10	2	4
3	30	1	3	*3*	13	21	11
4	8	13	19	*4*	5	4	3
5	68	5	21	*5*	8	3	12
6	5	2	9	*6*	1	3	3
7	6	21	17	*7*	4	2	7
8	17		5	*8*	9	6	6
9	14		12	*9*	5	2	10
10			6	*10*	4	3	2
2 min. moderated				*11*	6	3	2
1	53	10	1	*12*	23	5	2
2	10	2	7	*13*	2	7	4
3	28	2	2	*14*	8	6	2
4	3	5	4	*15*	3		12
5	9	40	2	*16*	4		
6	7	2	15	*17*	5		
7	3	3					
8	39	25					
9	19	2					
10	10						
11	17						

Figure A.1: Length and number of contributions collected from recorded moderator test meetings