An Interactive Appliance for Individual Well Being

Mechanical Engineering 310 Fall Design Document

Team Our Team Name
Person One
Person Two
Person Three

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1 摘要

Suggested length of this section: 2 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.
- 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 rather than something you've designed. However, it's possible that something from your CFP, CEP or Benchmarking gets the idea across.

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

Example text

在开放性较大的大学校园里，对环境陌生的人群往往需要一定的辅助来了解校园的设施、结构等信息。

就需求来讲，某个特定的场所可能有诸多的信息需要开放介绍，甚至需要对来访人员进行一定的导航、指引，而通过单一的静态信息可能无法达到较好的传递效果，以此为出发点，我们力图构建一个系统来改善诸如此类的信息展示功能。

对于这种有效信息的获取，其渠道是多元化的，在远程呈现的应用可能下，我们可以将其作为一种获取方式进行设计。让身处远方的“参观者”能够“身临其境”的感受环境，也即通过实时远程传递音频、视频等信息，并且让使用者“自主”的去寻找他们感兴趣的信息。同时，这种功能不只是单向的，通过远程呈现的平台，可以实现两地的人员的实时交流、咨询，也即实现一定的“虚拟出席”的功能，用以辅助环境信息获取的效率。

一个可以令人感兴趣的设计是一种集散控制的导航、参观系统。

旨在某一建筑物中配置一套机群，其移动终端为可移动的并且具有网络传输功能的“远程呈现机器人”，其基本功能是代替参观者虚拟出席到特定环境中，并获取基本的环境信息，对于移动性的控制，一方面可以由非现场的参观者通过某一指标（比如一张平面图的点击）来安全的（操作上存在一定的必要限制）控制移动，另一方面可以由现场人员在移动终端上直接输入指令进行辅助控制，该辅助控制也可以通过前述的平面图点击来封装化的实现。

这一套散布式机群的远程命令获取，是通过一台服务器的命令转发来实现的，用户通过网络与服务器建立连接，发送给定的指令，服务器负责将指令集中，转发到分散的特定的远程呈现机器人终端，这一设计便是集散式的系统分部。

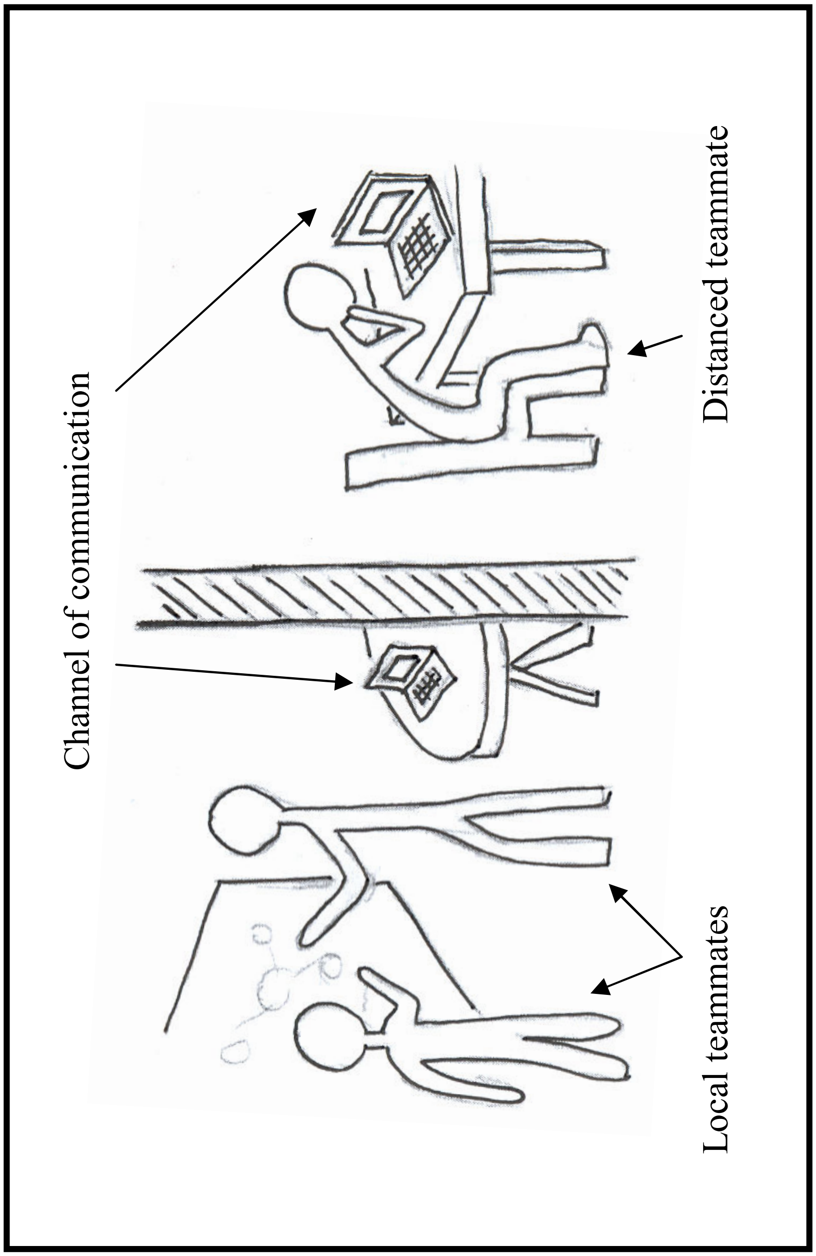

Figure 1.1: *Common result of destributed design meetings*

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.

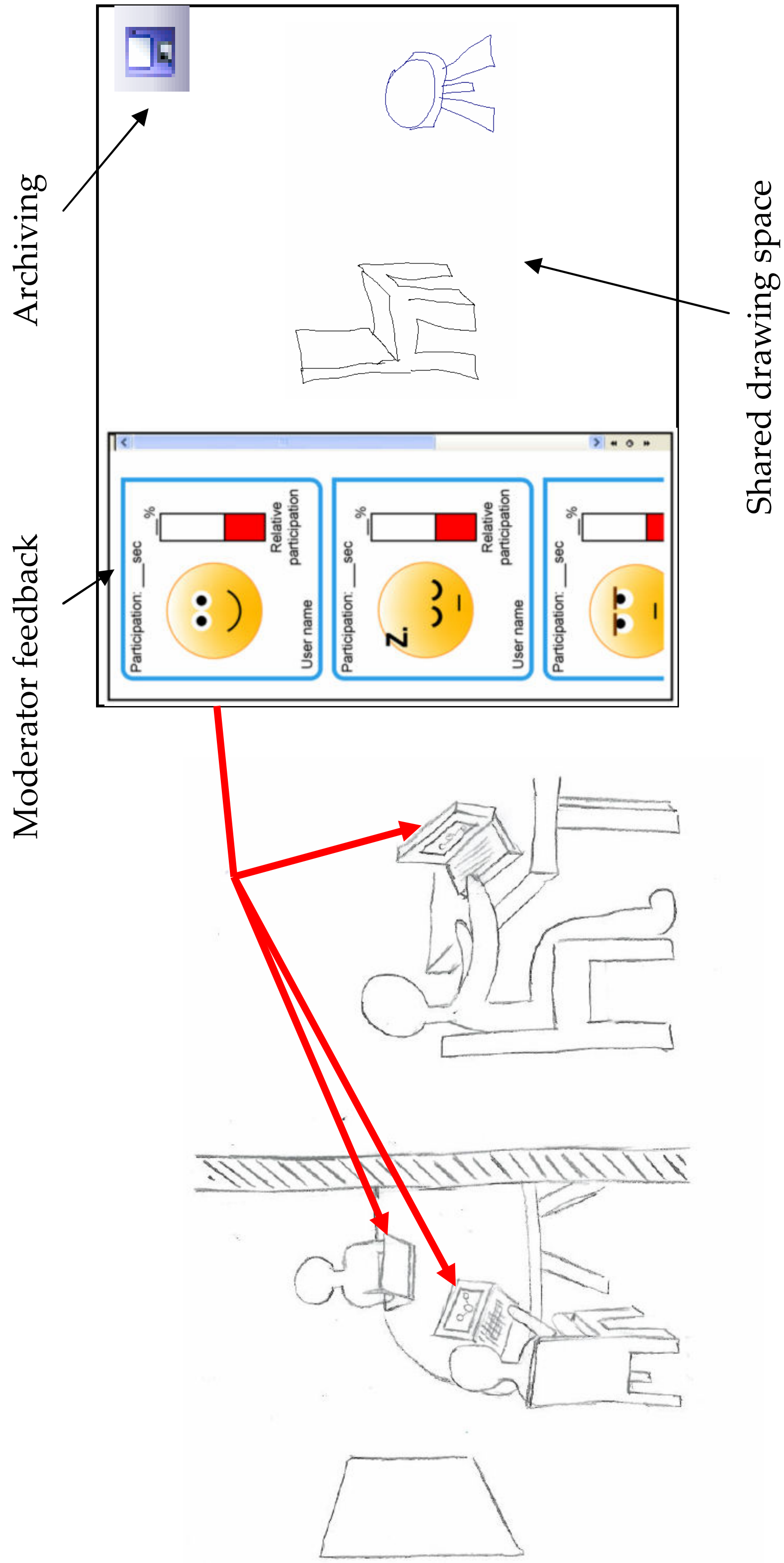

Figure 1.2: *Vision for a more effective distributed design meeting*

Contents

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Glossary

远程呈现 **(telepresence)** 是一种虚拟实在，能够使人实时地以远程的方式于某处出场，即虚拟出场。此时，出场相当于”在场”，即你能够在现场之外实时地感知现场，并有效地进行某种操作。

集散控制系统 **(Distributed control system)** 是以微处理器为基础的对生产过程进行集中监视、操作、管理和分散控制的集中分散控制系统，简称 DCS 系统。

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 背景

Suggested length: About half 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?
- What background or context set the stage for your Needfinding and Benchmarking, activities?

2.1 需求陈述

This section is the high-level result of your user need-finding. It defines 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 [?].

随着计算机、互联网技术的飞速发展，人与人、人与事物之间的联系日益密切，人们所接触的范围也逐渐广泛起来，于此同时，所需要的信息流量也会大大增加，传统的传递方式也许并不能很好的起到传递效果。如果让数字化介入其中，便会收获更好的结果。

试想一下，当某一个机构或部门需要向外界介绍他们的相关信息，这些信息会给参观者留下非常重要的印象，如果诸如此类的信息能够具有实时性、全方位性，并且能够充分调动参观者的主观感受，那么这些信息的价值便会大大提升。

通过远程呈现的基本构架，借助移动机器人提供的主观能动性，搭建如此的一个集散控制的参观导航系统，便会具有如上所述的极佳的效果。

当你身处千里之外，通过简单的互联网界面，点击鼠标、敲击键盘，就可以达到参观目的地的效果，而且这种信息的获取是实时动态的，该是一件多么惬意的事情，你一定会对目标地点有一个非常好的主观印象。而且，你还可以随时与那里的工作人员等互动交流，岂不是更加便捷、实用！

2.2 问题陈述

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

进一步分析目标，我们可以将过程中需要着重注意、解决的难题归纳总结，分成不同的项目部分，以备后续逐步实现预订功能。如下为分类：

- 网络连接搭建的方式

- 远程操作者的使用界面
- 机器人上显示界面
- 机器人的具体控制方式

对于网络搭建，由于之前的机器人必须通过附带的可执行文件来建立连接，而且 ip 地址是内网中的，这一限制对于我们所设想的系统有较大的限制，因此这一方式必须得到改进，使得连接建立简洁、可靠、广泛。

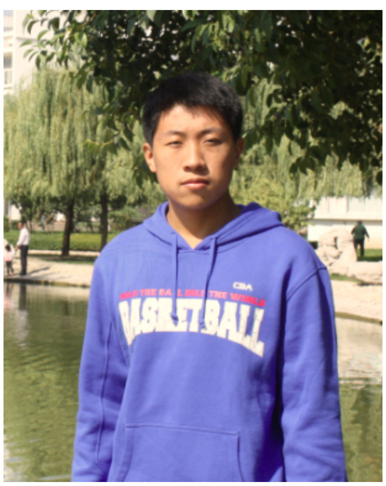
对于界面的设定，由于跨平台的优势，应该是基于网页界面的设计，具体的功能模块后续的设计中会逐渐添加，进而集成到界面中，以达到符合用户使用需求的目标。

机器人的控制方式也是一个非常重要的方面，他直接关系到了机器人的安全性等强制性的因素，而且对于用户体验也是至关重要的。

2.3 组员介绍

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 by the ME310 teaching staff, based on the outcome of Myers-Briggs personality tests (see Table **??**) and a desire to create teams with a diversity of interests and backgrounds. There is some evidence that such diversity enhances team creativity [**?**] [**?**], even if it creates additional challenges for team management.



王照栋
现况：中国科学技术大学，自动化系，10 级本科生
邮件：wangzd@mail.ustc.edu.cn
技能：基础机械结构设计，自动控制
编程： C 语言编程， 初步 C++ 面相对象编程，matlab

来自山东，2010 年考入中科大信息学院，后就读于自动化系。喜欢设计，并且具有一定的动手能力，2012 年暑期与同学组队参加过 Robogame 机器人大赛，并最终获最佳技术奖单项奖。课余时间比较喜欢参与一些运动以及益智类的活动，热爱乒乓球、篮球、羽毛球、游泳等运动，对魔方速拧还原有一定的研究。

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, as done in Table **??**. Because pdf files have scalable fonts, the print resolution will be good.

3 Design Requirements

Articulating design requirements is a critical task for a team that starts with a broad problem and needs to determine *what they should design*. After need-finding, and technical and user benchmarking, the team proposes a *class of design solutions* that fulfill *requirements* associated with the problem. In the Fall document, the initial Requirements Definition is the main item of value that teams can deliver to sponsors.

As the design process continues, requirements become more concrete and detailed. New *de facto* requirements are discovered and documented. Ultimately, competing designs are evaluated with respect to the requirements. If you can't tell whether a design satisfies the requirements, the requirements are too vague.

It is suggested to follow the procedure introduced in Fall quarter lectures and the Paper Bicycle Documents for defining and organizing requirements:

- Requirements (04 Oct. 2011): https://www.stanford.edu/class/archive/me/me310a/me310a.1122/cgi-bin/mediawiki/index.php/FallCalendar and handout on CloudSafe file server.
- Paper Bicycle Docs: https://www.stanford.edu/class/archive/me/me310a/me310a.1122/cgi-bin/mediawiki/index.php/PaperBikeDocumentation

The remainder of this section contains sample requirements (not an exhaustive set but enough to give an idea) from Autodesk Fall 2007-08 [?] and Audi Fall 2008-09 [?].

Introduction

The Autodesk collaboration tool must enhance communication between groups of distributed engineers as they engage in brainstorming. We have focused on enabling this collaboration via tools that:

- Enable users to communicate naturally and through multiple channels.
- Enable the team to better utilize their teammates, be they local or distant.
- Capture the information that was presented.

Our benchmarking and prototyping efforts have led to a more detailed definition of what the product needs to be in order to successfully achieve this. The requirements

Requirement	Metrics	Rationale
a brief description of what the requirement or objective is	measurable quantities associated with requirement (how to assess if a design satisfies the requirement)	why this requirement is important or valid

Table 3.1: *Three column format suggested for requirements (One can make a separate table for each cluster of related requirements).*

address what the product functionally needs to do and what it physically needs to be. Because of the wide range of functional opportunities that exist for the product, few physical restrictions are imposed at this stage in the design.

3.1 Functional Requirements

Requirement	**Metrics**	**Rationale**
The product will balance the number of interactions in distributed design meetings among the team members.	Interactions are questions or statements that develop a concept. The total number of interactions per person during a design meeting will be called n_i. The solution must reduce the standard deviation of n_i between team members as compared to the closest publicly-available competing product.	The number of times someone interacts in a meeting is one measure of engagement. Brainstorming is a highly social process which thrives on the input from a variety of perspectives. By effectively improving the communication between distributed teams, team members will be more engaged and participate more.

Table 3.2: *Requirement for improved communication*

Requirement	Metrics	Rationale
The solution must transmit sound at close to the rate of normal conversation.	The listener must hear the speaker with less than 0.3 seconds lag.	Audio latency creates a sense of distance. Mobile phone to mobile phone conversations have an average latency of 0.3 seconds, which is noticeable but not disruptive.
Users can capture drawings to share with distributed teammates that are legible.	Input device must be able to resolve a drawing at 50 points per inch (specifically, they must capture 50 percent contrast modulation at this frequency).	Drawings by mechanical pencil and ball point pens typically have lines of 0.5mm thickness, which translates to a resolution of 50 points per pinch (ppi).
Users will be able to capture drawings to share with distributed teammates without disrupting the flow of the discussion.	Drawings must be captured and sent within 17 seconds. This is assuming the input device is properly set and there are no external complications.	We found through benchmarking that sketches are used primarily when describing a concept, and are of little use afterwards. The sketches must be captured and sent before the context of the discussion has changed. Seventeen seconds was found to be about the average comment length during brainstorming in our prototyping.
Users will be able to see the drawings clearly.	Drawings must be displayed with a resolution of at least 72 ppi.	The display must be able to resolve at least as a standard computer monitor.

Table 3.3: *Required mediums of communication for effective concept development*

3.1.1 Functional constraints

3.1.2 Opportunities

- Utilize existing tools. There are many collaboration and input tools that exist out there. Our product does not need to be a replacement for them. It could potentially supplement them.
- Offer new lines of communication:
  - Facilitate side conversations between distributed users.
  - Utilize the uncrowded channels offered by other senses than audio/visual, such as tactile.

Requirement	Metrics	Rationale
The tool must be able to be started up quickly for impromptu meetings.	It must be able to be started in less than 40 seconds. This time is calculated from the moment someone decides to start the system, to the point when the tool is ready to use, with full functionality. If the solution requires use of personal laptops, assume these are already booted up.	Our benchmarking has shown that collaboration tools can fall into disuse if it requires a lengthy setup time. This amount of time is within the range of initiation times for multiple popular conferencing solutions.

Table 3.4: *Social requirements for effective design meetings*

Requirement	Metrics	Rationale
The bandwidth required must not be prohibitive to standard engineering offices.	The product will require less than 100 Mbps.	The population of potential users would dramatically decrease if the product required more connectivity than a T1 line, which is typically around 100 Mbps.

Table 3.5: *Functional constraints*

- Be the moderator:
  - Collect feedback from users directly, via voting, or indirectly. Enable the replacement of video, which conveys very little useful feedback during design meetings.
  - Encourage the participants to be engaged by monitoring participation.
  - Display feedback and participation to attendees non-verbally,potentially through the use of avatars.
- Allow for easier information capture and storage
  - One button information capture
  - User-driven archiving
- Assist user communication in non-native languages.
  - Audio buffering
- The product should be accessible
  - Usable for low bandwidth connections for
  - Be fast to setup.
  - Able to be setup within a typical conference room.

3.1.3 Assumptions

- Each user has, and is able to use:
  - a personal laptop
  - a mouse
  - a microphone
- Users will speak with a volume of at least 30 dB, as measured when 1 meter from the microphone.

3.2 Physical requirements

For variety, here is a requirements table 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 3.6: *Physical Requirements from Audi 2008-09*

4 Design Development

- The design is the protagonist of the story; the design team is only a supporting character.
- Focus on results (e.g., key findings, insights, lessons learned), not activity ("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.
- Lengthy details (e.g. detailed results of technical benchmarking) should go in an Appendix section, with an explicit forward reference from this section.
- Be professional: for benchmarking, 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 [**?**, **?**, **?**].

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

The broad scope of our problem statement allowed the team members to use their imaginations and arrive at creative solutions. 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 we balanced pushing forward with our current ideas while constantly looking for new directions.

4.1 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:

4.1.1 Communication

- 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.

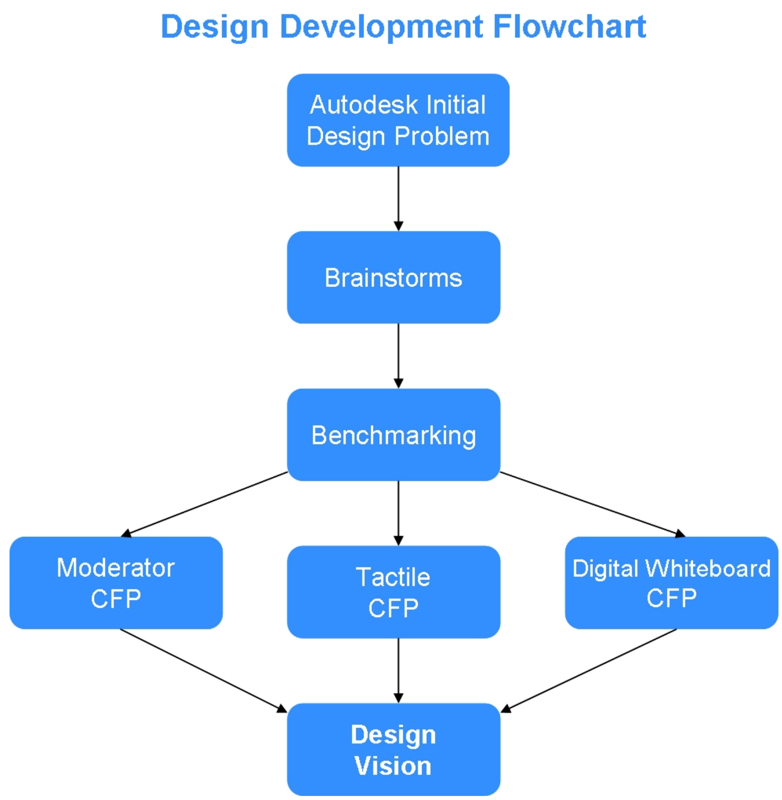


Figure 4.1: *The design team's development process.*

- 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 multiplayer 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.

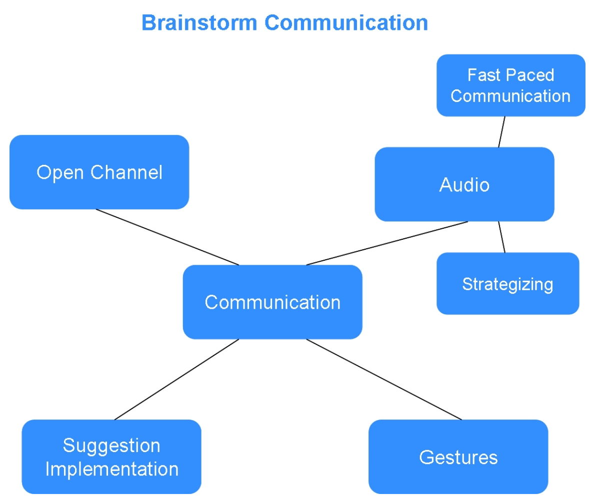


Figure 4.2: *Key components of communication in design meetings*

4.2 Research and 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 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.

4.2.1 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 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.

4.2.2 CyberGlove ®

Figure 4.3: *People playing Wii Sports on the the Nintendo Wii ®. Ideally there would be a citation to the URL this photo came from.*

Figure 4.4: *CyberGlove ®gesture-based input device. Ideally there would be a citation to the URL this photo came from.*

The rest of this subsection is omitted for brevity

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

Figure 4.5: *Example of the first available wireless EEG tool, made by IMEC. Ideally there would be a citation to the URL this photo came from.*

Key lesson learned

- Electrodes could be placed on the users forehead and scalp 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

4.3 Critical Function Prototypes (CFP)

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.

4.3.1 Tactile CFP

4.3.1.1 Tactile CFP Concept Development

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.

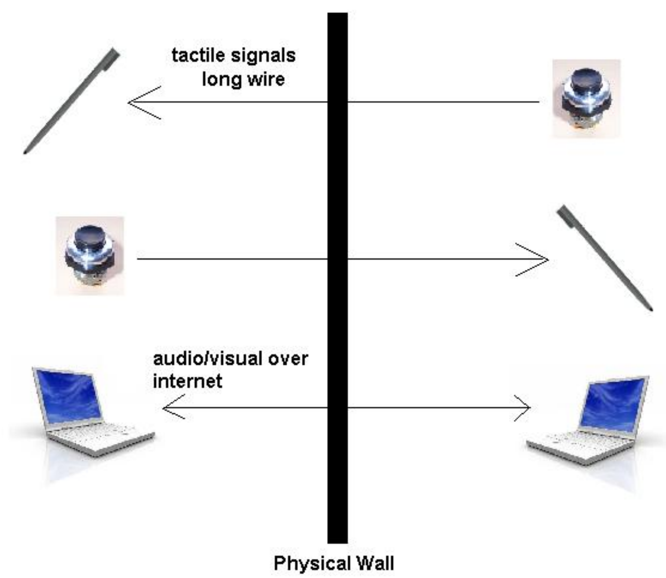


Figure 4.6: *The team's whiteboard during a brainstorm session*

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.

4.3.1.2 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?

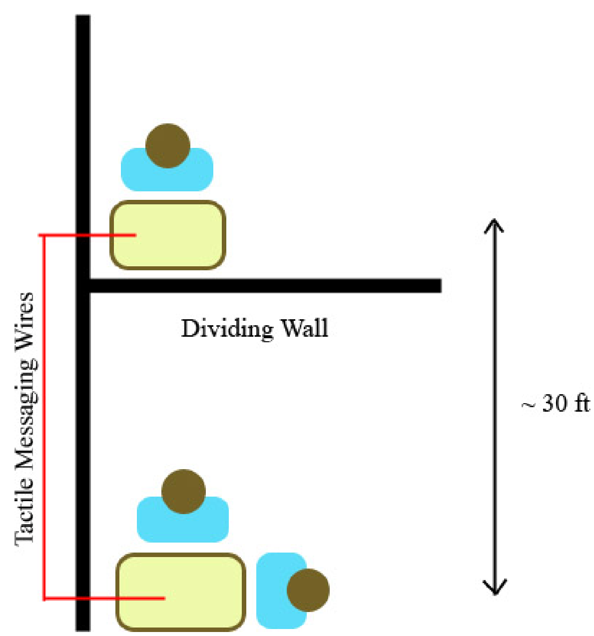


Figure 4.7: *The orientation of the two tactile messaging stations.*

4.3.1.3 Lessons Learned

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 **??**.

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

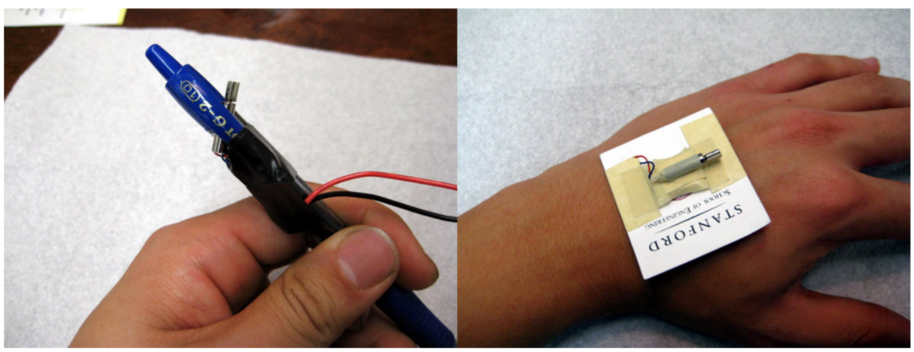


Figure 4.8: *The orientation of the two tactile messaging stations. (Note: the wires connecting the patch to power supply are not in this photo)*

5 Design Description

The description section defines what the design is. If you find yourself adding rationale, or discussing design alternatives, you are writing text that should be moved into the Development section. A few teams find that this section fits more naturally if it comes before the Design Development section.

In the Fall quarter, the design will be in an early stage and this section is largely a proposal for what the design should be (you can call it that, explicitly). Even so, on the basis of preliminary need-finding, benchmarking and critical function evaluation, you have some idea of what is appropriate. Take a point of view and assert it. A CAD model or systems diagram of a concept may be appropriate.

5.1 Vision

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.

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

5.2 Tactile Messaging CFP

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.

(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.

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.

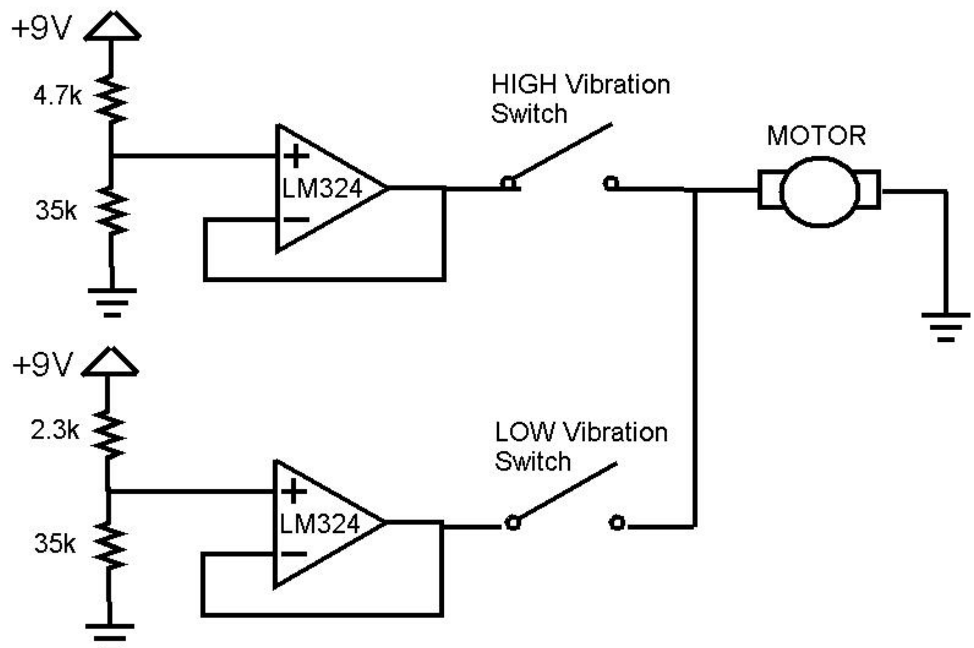


Figure 5.1: *A simple voltage dividing circuit provided 1.2V (HIGH) and 0.6V (LOW) buffered output voltages for the vibrating motor. Switches triggered the high and low voltages.*

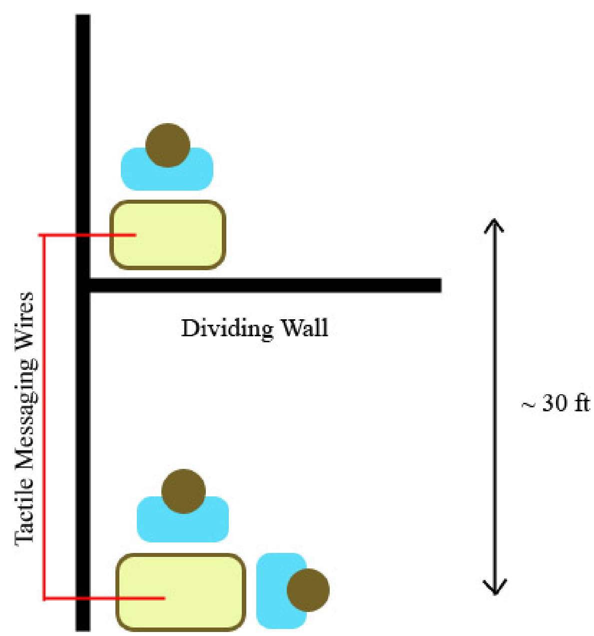


Figure 5.2: *Layout of seating during test meeting. Two participants met on one side, with the remote user separated by a wall 50 ft away.*

5.3 Moderator CFP

5.3.1 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.

(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.

5.3.2 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 **??**.

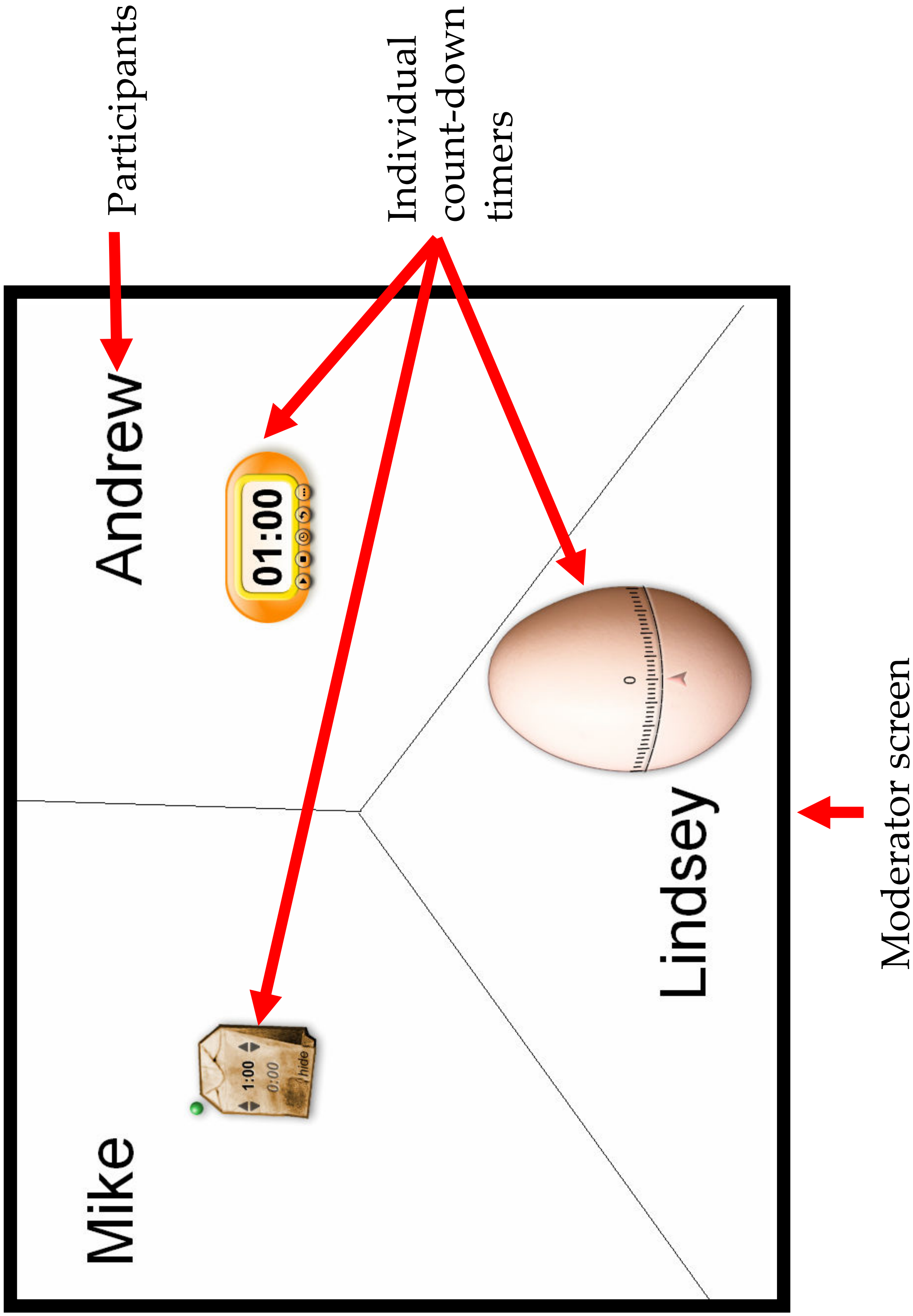


Figure 5.3: *View of moderator display*

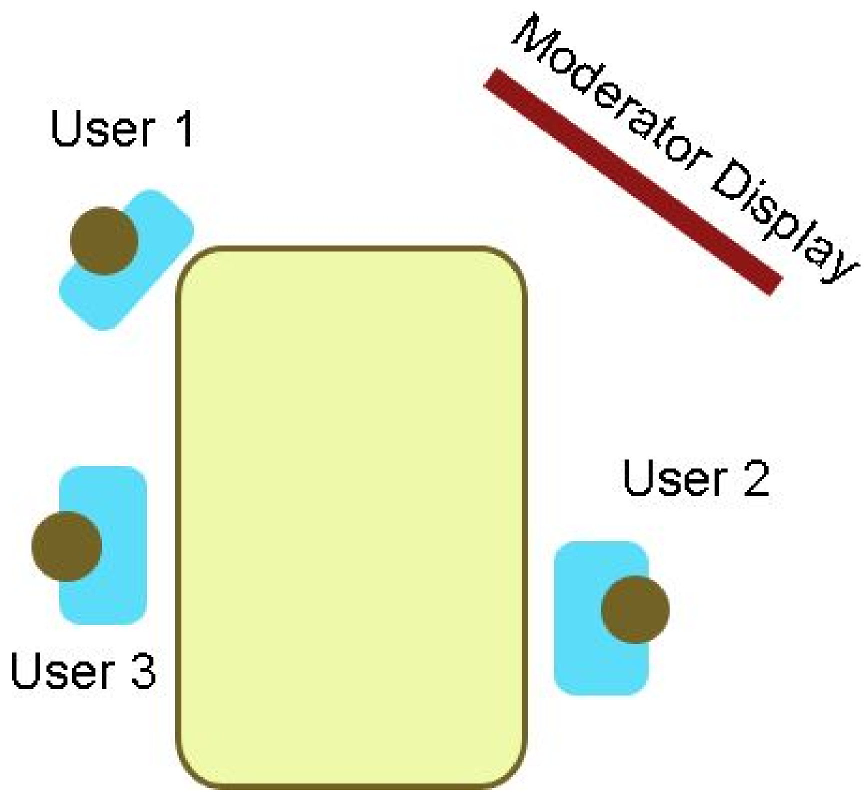


Figure 5.4: *Layout of design meeting with moderator prototype*

6 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.

6.1 Deliverables

Define briefly what is or will be delivered. 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:

- Paper Robot (Jan 11-13) – a mechatronic warm-up for winter
- Dark Horse prototype (Jan 25-27) – a 2nd CFP that probes the edge of the design space
- Travel Docs due (Feb 8)
- Funky Prototype (Feb 10) – a CFP where a potential avenue for the final product is developed
- Turning Point presentation (Feb 24)
- Functional Prototype Review (March 8-10) – 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 (March 17)

6.2 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.

6.3 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.

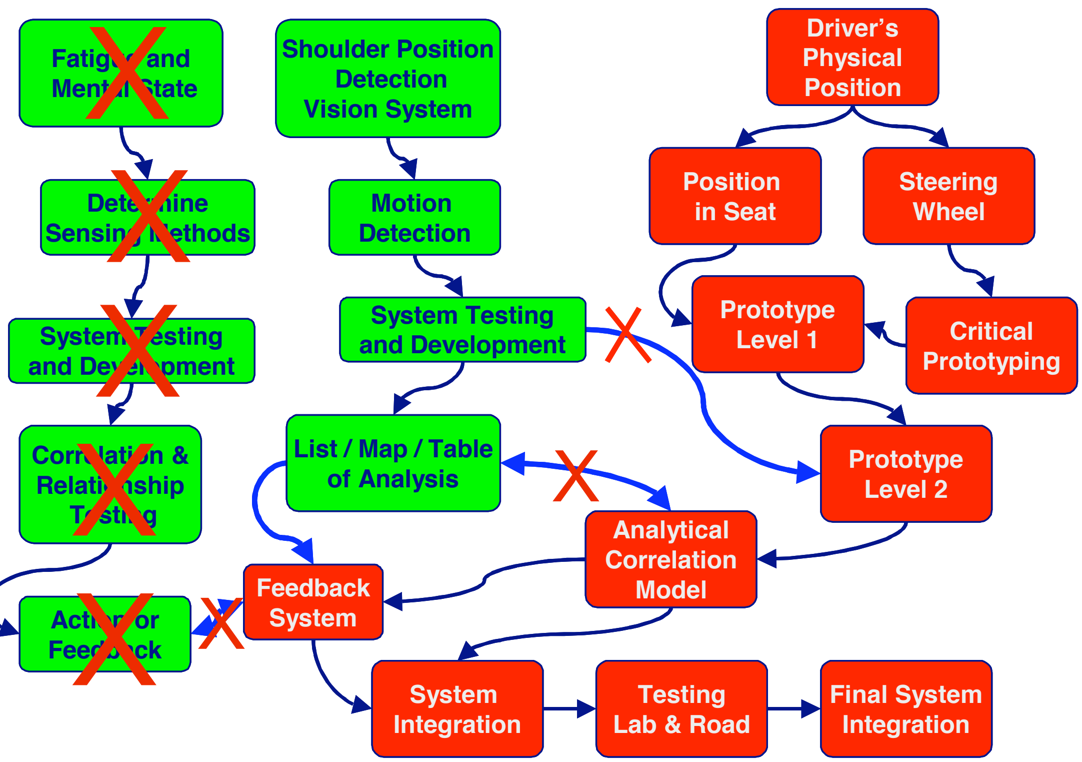


Figure 6.1: *In this example from [**?**], Stanford students collaborated with a group at TMIT, Japan. At the end of the Winter quarter it was decided to abandon one branch of the TMIT effort and to eliminate some of the tight coupling that was originally envisioned.*

6.4 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.

6.5 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.

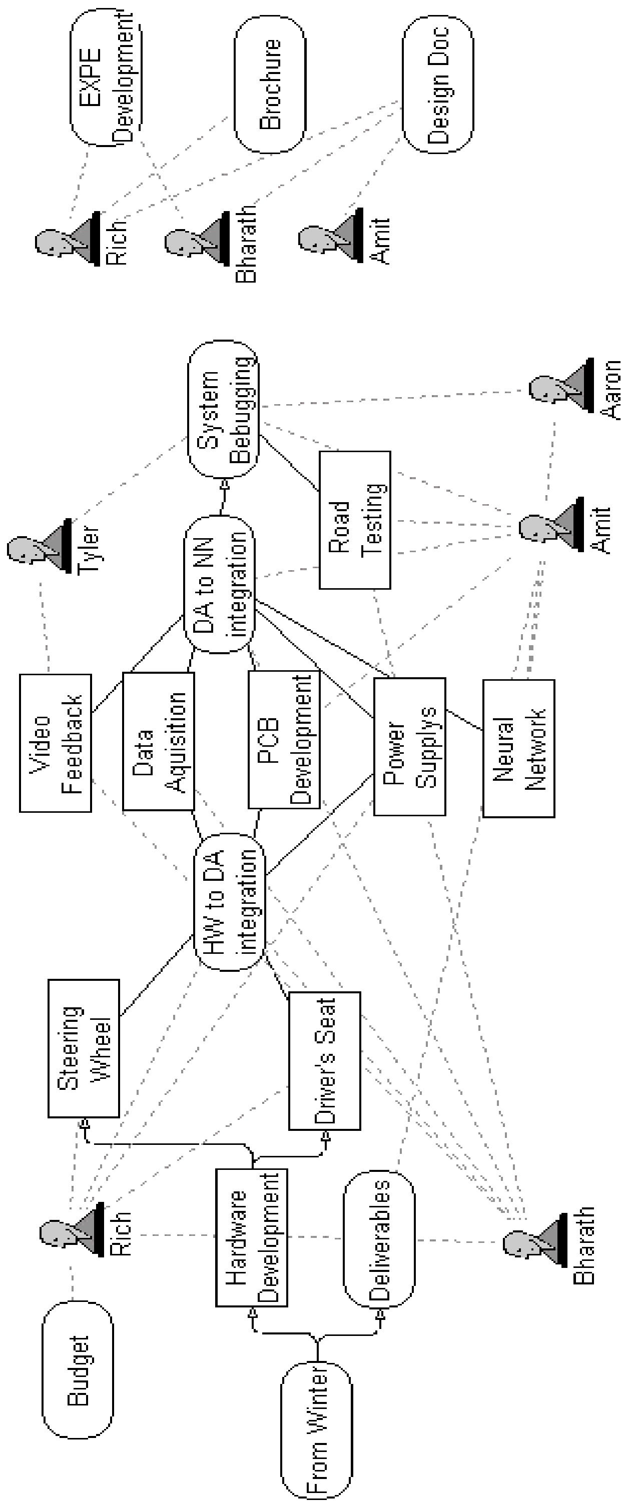


Figure 6.2: *An example of taking a large figure and having Latex rotate it 90 degrees to display it in landscape format as a full page figure.*

6.6 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.

A part of this may include how your team functioned in the fall - explaining how and why your actual design process deviated from what you originally planned, if relevant. (Time lines and milestones often have the look of having been concocted the night before the report is due.)

7 Reources

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

Appendix A

Moderator Prototype Data

Adapted from Autodesk Fall 2007-08 [?].

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

	Length of Contribution (s)		
# Contribu	Andrew	Mike	Lindsey
1 min. moderated			
1	14	12	8
2	10	2	4
3	13	21	11
4	5	4	3
5	8	3	12
6	1	3	3
7	4	2	7
8	9	6	6
9	5	2	10
10	4	3	2
11	6	3	2
12	23	5	2
13	2	7	4
14	8	6	2
15	3		12
16	4		
17	5		

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