Mindfrog Thesis Conclusion and Defense

The goal of the Mindfrog Project has been to show that computer-aided tools utilizing wireless, video, audio and streaming technologies based in time and space, impact relationships and communication. At its core, the Mindfrog group is developing “telepresence” technology where telepresence is defined as the ability to experience someone else's environment through transformative linkages managed by digital media.

To understand the success of this project one must address each technological focus, then look at their unification into a prototype and assess the conclusions drawn to questions posed in the original Mindfrog thesis proposal. In addition to these academic goals, Mindfrog also set milestones and criteria for evaluation in its original proposal that need validation to justify a successful thesis project.

This paper will address the aforementioned objectives and delve into the appropriate detail allowing for a summarization of this yearlong project into a success statement. Although every specific detail discussed in the original proposal has not been met, Mindfrog believes any deviation from the original proposal is negligible and will show an appropriate justification for the deviation. With this in mind, Mindfrog considers its thesis work an overwhelming success.

As mentioned, each individual technological focus requires a detailed review to assess Mindfrog’s thesis. As predicted, wireless technologies have grown more sophisticated in the past year: growing from the 128kbps metropolitan wireless bandwidths to the nationally available satellite driven bandwidths of more than 1.5 Mbps. Mindfrog’s reasoning for using wireless LAN technologies was grounded in the assumption that public Internet traffic would increasingly be broadband and wireless. By growing 10 fold in one year the public wireless bandwidth market has justified Mindfrog’s decision to use wireless LAN technology to simulate public wireless bandwidths in the next 1-5 years. By using the wireless LAN technology as a model for future commercial bandwidth, Mindfrog has been able to work outside of the current constraints facing technological developers. Mindfrog considered dozens of wireless solutions and finally focused on Cisco Systems’ Aironet Wireless LAN product line. With bandwidths of 11Mbps and coverage of more than 150 ft indoors (1000 ft outdoors) the Aironet wireless technology offers Mindfrog a cost effective solution as a robust foundation for its prototyping work.

Recent developments in mobile processing power have also enabled Mindfrog’s vision of complex, rich-media in a mobile environment. After extensive research with companies like Xybernaut and Mindflux, Mindfrog decided on a powerful IBM laptop as its core mobile processing unit. With a fast 850MHz processor, 256 MB or RAM and built in video capturing capabilities, IBM’s “Thinkpad” is the ideal workhorse for such a media intensive project. Justifying our assumption that processing power will migrate mobile computers into mobile media rich workstations, IBM and Sony have not only doubled their laptop speeds every 6 months in the last

year, but they have both integrated video camera's and on board capture devices on their most recent product releases.

In order to transmit data from the laptop via the wireless LAN to the Internet, our media needed to be converted into a standard streaming media technology. At the time of the original proposal Real Networks Real System G2 was the market standard. Today Real Networks is on it's second update using Real System 8 and Microsoft's Windows Media Technologies and Apple QuickTime have a growing percentage of the streaming media market. Mindfrog is still focused around Real Networks (having upgraded to Real System 8 upon it's release during the project) as the foundation for it's streaming media solution. We have test both Windows Media Technologies and QuickTime vigorously and although we have implemented both Real Networks and Windows Media Technologies in our prototyping work, we chose Real for their on going market share dominance.

At this time it is important to note the one deviation from the original proposal. Initially, Mindfrog had set the goal of being able to stream stereoscopic, binaural audio in real-time. Due to the state of several emerging technologies within the video capture industry, Real Networks (as well as QuickTime and Windows Media Technologies) will not process a live video stream in the manor necessary to transmit live stereoscopic video.

Although this may initially sound significant, in actuality Mindfrog's concepts and a large portion of hardware and content development have been proven. Using Real Networks, wireless LAN and it's prototype hardware, Mindfrog can capture, transmit and receive stereoscopic video and binaural audio asynchronously. Furthermore, using Real Networks, wireless LAN and it's prototype hardware, Mindfrog can also capture, transmit and receive monoscopic video and binaural audio synchronously. Simply put, if a relatively complex piece of code, called a device driver, would be written by Real Networks, Inc. supporting one of the four common industry capture devices usable by the Mindfrog prototype, Mindfrog would have met it's streaming goal in it's entirety. We attempted to work with Real Networks and although their staff was very helpful, our specific development requests did not map to their priorities in building mass marketed Internet tools for consumers. Rather than delve into the complexities of operating system programming, Mindfrog refocused our efforts on content and audio interactivity confident we had tried every possible solution to meet our objectives.

Thanks to a fairly recent endeavor by a group called the OpenH323 Project, our customized coding efforts have been focused on developing a Voice over Internet Protocol (VoIP) solution for our audio based interactivity. Our original concept was to have 2 dedicated channels of audio, artificially oriented in three-dimensions, for users to spatially differentiate multiple interactancts. During the research of VoIP solutions we found no support for stereo audio needed to generate the artificial spatial orientation. Also through further discussions we agreed that setting a limit or participants would defeat the potential of the Internet. Agreeing to forgo the

spatial placement of a handful of participants, Mindfrog worked with the OpenH323 Project to build a server supported VoIP solution that can manage hundreds of simultaneous participants in a single conversation. Although a minor deviation from the original proposal, our final solution truly leverages the Internet's potential for simultaneous mass interaction.

Having shown successful development and understanding of each individual technology, the culmination of interactive mobile wireless computing through streaming media and VoIP into one fully functional prototype is a success in and of itself. To fashion a prototype, which linked these usually, separate technologies into one machine required some custom hardware development on Mindfrog's part.

- Mindfrog built headgear for capturing stereoscopic video and binaural audio.
- Mindfrog built multiplexing chips in order to interlace a stereoscopic signal into one data stream, which then could be managed by Real Networks.
- Mindfrog developed hardware to correct the time base of each video signal in order to assure the synchronized quality of the multiplexed video signal.
- Mindfrog researched and reworked several beta releases of hardware and software which allowed for the "de-multiplexing" of the video signal into 2 separate videos that when viewed together create a stereoscopic video.

By filling the gaps between the standard technological solutions with custom hardware and software, Mindfrog successfully developed a prototype capable of the original vision: synchronous telepresence.

Amazingly the prototyping took only a little longer than projected by the milestones so by the last Quarter Mindfrog was aggregating content from varied people including team members and local talent outside of the graduate program. The first taping took place in a San Francisco nightclub at the beginning of April. Working through some minor technological adjustments, the first successful telepresence event occurred with Skip, a San Francisco videographer. Until our prototype was built and operational, we could not assert any validation on the theories proposed by our thesis. With Skip's telepresence experience we began to see the impact our technology had on users both physically and psychologically. Although not all the responses are focused on specifics, the user feedback from the original 5 participants lends itself to assessing primary and secondary effects on users of this technology. Some varied quotes from all the participants in our telepresence trials follow:

Skip

" Because my roots are deep in inter-personal documentary film making...this system intrigues me completely.... being able to record from my point of view without having to hold a camera freed me to interact with people in a more realistic way..."

Celine

" I think the is a very cool idea... being able to see my point of view of reality, and it went so well with my costume!"

Rane

“My points about acceptable weight. The weight is okay, but wearing the headgear for prolonged periods of time really dug into my nose, and I wanted padding on the prototype. Bowie complained of the same thing to me – in fact he warned me as I was putting it on. I said that it 'was heavy'.”

“As for ‘sharing’ with others what I experience. I think I felt more protective of people that I knew, more than I would have been if the cameras were viewing me. From my POV, it means what I see, who I talk to etc. It seems very much like an invasion of privacy. I didn't feel it was an invasion of privacy of dogs in anyway. People are a different story for me. I knew some of the people and they agreed to be on tape before hand. I felt I owed that to them.”

Bowie

"The experience in itself wasn't anything too much. It was fairly comfortable, at least until I took them off where I found out I only adjusted to the weight. The ride was normal, though with them on I had a new appreciation for the excitement in a simple ride to a store. The way things explode out to my vision that I never truly noticed before. In a way, it was eye opening. In others... it was is there was really no big difference. Just like it probably should be."

"I felt relatively normal with other people around, as awkward as the gear was. As any person who's a 'spectacle', there's a certain air which makes you want attention-- and in some cases, it's received. It's a fun feeling, and a really interesting experience to at least test the reactions of the people you encounter."

Siggi

“I think the wearable is comfortable to wear. It's light weight. In a perfect world it would be ideal to be able to minimize everything down to sunglasses and a PDA. But that's later down the line.

In term of someone else experiencing my POV, I think regardless of the technology the 'experience" will never be more interesting than the connection between the involved parties. But as Jean Luc Godard speculated in the 60s about film..."In the future reality will exist at 24 fr pr second".. Just imagine how much more reality will exist at 30 fr pr second on digital broadband!”

Using these comments and Mindfrog’s own personal account of the technology in conjunction with our secondary research we can begin to delve into the questions relating to relationships posed in the thesis proposal.

Mindfrog attempted to approach our project in a manner that would allow us to discover the implication of our technology in immersing ourselves in the observer effect. Our initial goal was to highlight the context of telepresence rather than banish the context in an attempt to describe or explain the patterns identified with attention to the human dimensions of co-discovery with our participants/users. This goal was not met entirely as previously mentioned delays in prototype building left us in the situation of basically using participant responses and first-hand experiences to infer what immersion in the observer effect would or could be. More research is needed to be done to explore these questions fully, and to see if the questions we entered this project with are even appropriate questions.

Having said this, we have formulated answers to some initial questions regarding the Technology Actor Network Theory (TAN). In TAN, the more passive elements are 'actants', the more active, "actors". In wearing the gear and moving among people recording others, one can become an actant as the recorder rather than an actor. It is possible to move between these two roles depending upon the situation and the personality of the wearer. A person can be sublimated to the role of a camera. Therefore, it is possible to infer that cyberspace relationships can become more network-oriented, possibly moving the human recorder to the role of a mechanistic machine, or an 'actant'.

This can create a relationship with a different type of social agency. The person recording can disappear from an interaction. It is also possible as Bowie suggested that you can test reactions of those who become participants because of the gaze of the recorder. The reactions of people being “viewed” is affected by the gear the recorder wears. Skip suggests that he is able to interact in a more realistic manner as his hands were free while documenting those around him. Celine referred to the gear as something she wore, that it fit in with her costume.

It is possible that intimate relationships are created with the gear itself, as well as the 'voice in the head' when the recorder gets to know the others that communicate with them via VOIP technology. The social correlates of friendship formation of less face-to-face and more

screen-to-screen communication is difficult to discern through our limited tests. The addition of being able to have voice communication with something that you see through the screen, the gestures and facial expressions of the wearer/recorder are still obscured, however one is able to communicate and listen to the different intonations through the voice over communication. This is different from screen-to-screen technology of previously studied cyberspace relationships, because of the addition of near real-time voice communication. Any sound that the wearer/recorder makes is picked up and transferred to the connected person participating in the telepresence. This engagement can be likened to one speaking to oneself with the addition of responses. Collusions are also possible in terms of what to look at next, where to go, how to move through a group of people. This type of behavior is seen in screen-to-screen relationships where a webcam is situated in front of a performer and communication occurs via text chats.

Video streaming coupled with verbal communication can indeed impact friendship formation in this hybrid of screen-to-screen and face-to-face communication. Though it is important to realize that it is not face-to-face, but rather faceless-to-faceless communication. A similar model exists in group phone conversations where people find themselves talking to one another; getting to know one another. Mindfrog's telepresence prototype allows someone to communicate with others as they get to know the prototype wearer by what they look at and where they move within a culture. The level of intimacy is always predicated upon the personalities of those wearing the gear, and those viewing the "point of view" of the wearer.

Communities in cyberspace seem to have more to do with similar interests than a common cultural pattern that is based upon location. "Net" relationships are not dependent upon 'place' or 'location'. They are instead dependent upon common areas of interest. These communities are more network-oriented rather than group-oriented. Mindfrog placed people in various settings of their own choosing. The viewer-participants select what is more interesting to them to view, and in this respect they are already pre-selected as mutual interests. Using the brief intro's associated with each telepresence experience, the viewer can select with who to communicate. People are no longer 'bound' by skin as a way of thinking about identity and who we communicate with, we are freed from the need to be physically present and to have face-to-face communication. This changes the concept of who we are as an entity, though it hasn't revolutionized how we view ourselves as entities. Proximity is no longer important, and these relationships do appear to accelerate the decoupling of space from place.

The ability to connect with others, to form a communication link in a network set up such as in the Mindfrog project enables the viewers and recorders to potentially share what either imagines and thus can create a sub-culture of 'regulars' who interact with one another. Cultures are created and evolving. Facilitation of a new 'location' (the Mindfrog site) for various forms of communication creates a go-between to foster cultural explorations.

ANT (Actor Network Theory) is an active process in terms of creation of a particular technological network. The Mindfrog project has created this ANT to actively pursue a new form of relating, the humans involved in this ANT have agency and the ability to 'act' as do the non-human actants, such as the multiplexor, the wireless LAN, etc. These actants can be transforming and have transformed how we interact with one another and the network itself.

In addition to the empirical data collected from filed us of the prototype, as well the additional knowledge gleaned from the building of the prototype, Mindfrog spend many hours sifting through a wealth of information both in technological and theoretical areas. To add to the primary research, Mindfrog used the traditional research methods of journal and library research in conjunction with non-traditional methods on on-line research (e-mail interviews, listserves, newsnet, etc) as well as field trips to conventions, corporations and other universities. All of our resources are documented on the Mindfrog website (www.mindfrog.net).

Finally, having shown successful engagements in every portion of the academic experience, we must also address the specific criteria for evaluation and corresponding milestones agreed upon in the original thesis proposal. Mindfrog's Criteria was divided into 3 phases all of which have been met. Phase 1 required several technological foundations to be built including the mounting of camera's enabling stereoscopic capture, binaural microphone development and associated logistics of resolving line/mic level incompatibilities, and development of a head mounted display. Mindfrog achieved Phase 1 criteria by the end of the first quarter per our milestones.

Phase 2 required a conversion from the analog technology of Phase 1 to a digital solution. Phase 2 included using a wearable or laptop (as mentioned Mindfrog is using a laptop) to digitize video and audio, resolving any stereoscopic issues, and initially validating our hypothesis through empirical research derived from using the prototype. Again, Mindfrog achieved it's goals per its projected milestones, although the empirical research was delayed by several weeks as prototyping took longer than expected.

Phase 3 required that the prototype be "minimized" and that Mindfrog can support our hypothesis through primary and secondary research. Mindfrog has also achieved Phase 3 successfully. Due to budget constraints, Mindfrog's prototype is actually larger than it could be. With an additional several thousand dollars, Mindfrog's prototype could be condensed into a laptop with a cigarette pack sized external adapter, plus the camera and microphone headgear.

Support of our hypothesis, that computer-aided tools utilizing wireless, video, audio and streaming technologies based in time and space impact relationships and communication, has also been achieved. As can be assess from our complimentary research on the Mindfrog site (www.mindfrog.net), we have shown a significant correlation between the way people communicate between themselves and others and the perceived space and time associated with that communication. This new communication impacts identity on an individual basis, it impacts

relationships in a group environment and therefore impacts culture at large assuming the technology has significant adoption in any given mass of people.

In summary, having built an astounding technological prototype, Mindfrog has combined software, hardware and theory into a platform to validate it's hypothesis and meet the requirements discussed in the original thesis proposal. By developing a physical tool and potential on-going research prototype, Mindfrog not only meets it's thesis objectives successfully, but transcends it's year long project work and offers substantial longevity to the research performed by the interactive mobile computing community.