

Touching Other Worlds: Remote Gesturing in Collaborative Physical Tasks

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Abstract. Work is being conducted on the representation of non-verbal gesture in video-mediated communication systems for the performance of remote collaborative physical tasks. This work, based on the traditions of Chapanis (1975) and Fussell et al (2003), seeks to explain the effects of gesturing using theory developed within the framework of Distributed Cognition, and will also consider how gesturing systems could be designed to support workers in the field.

1 Remote Gesturing

The seminal work of Chapanis [1] demonstrated how variations in communication media can affect productivity in remote collaborative physical tasks. This work however highlighted a problem in video-mediated communications; in measures of productivity a video-link can never improve performance beyond the capabilities of an audio only link between remote locations. It seemed completely logical that a video representation should offer something more than an audio-only link but both communication media (audio-only and audio-visual) offer comparative levels of performance and neither have ever been as successful as side-by-side co-present communication, this effect has been supported by more recent research [2].

Much of the experimental work on remote collaboration since Chapanis has been based on working with 2-Dimensional tasks, which can be adequately completed using groupware packages. Work that has occurred on collaboration using actual physical tasks has developed along a couple of alternate strands of research and on the basis of work at Carnegie-Melon [2,3], it became clear that most remote collaboration technologies were probably never as good as side-by-side communication because there was no representation of the interactants' non-verbal gestural behaviour. Independently, Kuzuoka et al [4] have developed systems to represent gesture. Building on the work of Kuzuoka the latest work from Ou et al [5] at Carnegie-Melon has demonstrated significant performance benefits over audio-visual links between remote participants engaged in collaborative physical tasks when using their gestural representation system Drawing Over Video Environment (DOVE).

Coming from a psychology-ergonomics perspective the work I am conducting within the Mixed Reality Lab is addressing the issues of how simple representations of non-verbal behaviour can be utilised in video-mediated communication to facilitate performance in remote collaborative physical tasks, tasks typified by a problem solving exercise. Using simple video-projection technology the gestures of an 'expert' can be captured and then posited into the working environment of a remotely located collaborator who is working with the shared artefacts. This technique creates a mixed reality surface at the level of the remote worker's task space. Pairs of participants have collaboratively assembled Lego kits, one participant playing the role of 'Expert' (having the instructions and a video link to the task space) and the other participant being the worker. Using an experimental paradigm I have compared participants' performances when the Expert has the ability to have their hand gestures projected over the working surface of the remote worker and when they only have the video link. My work also tries to explain the effects of gesturing using the framework of Hutchins' Distributed Cognition theory. I have so far examined how gesture representation affects measures of performance, mental workload and certain linguistic parameters in this context.

My future research will investigate different formats for both gesture representation and display, and the contextual consequences. It is likely to also consider multi-party interactions and the dynamics of expert-unskilled participant interactions. Consideration will also be given to the design of gesturing systems for mobile workers, so at some point it is quite likely that I will want to pursue work-practice studies to investigate how gesture representation systems could work in-the-field.

My attendance at the workshop will hopefully benefit others by my provision of research findings relating to the benefits of gesture representation in collaborative physical tasks, and I will hopefully be able to gain a perspective on the benefits of a more out-of-the-lab approach to the problems being researched in this area.

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References

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