# Towards a Gesture Repertoire for Cooperative Interaction with Large Displays

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Future, 'smart' environments are emerging rapidly: in meeting rooms, in public areas and in the home. They are fraught with new, computational technologies that demand easy access. Human-computer interaction (HCI) develops 'natural' interfaces that analyse, react to and are based upon natural human behaviour [1]. We study a key natural interaction modality, manual gesture input, with large displays in smart environments for face-to-face single- and multi-user settings.

Gesture input has traditionally been based on a repertoire of predefined, single-user gestures. Such a set of predefined gestures can easily become idiosyncratic, which does not match the—intended—natural interaction. We describe preliminary work on a series of user-centred experiments that lead to a natural gesture repertoire for HCI in both single-user and multi-user situations.

### A Real World Context: The Life Sciences

The life sciences are the setting for our research. The *e*-BioLab, under development by the Microarray Department headed by Timo Breit at the University of Amsterdam, is used by life scientists who are involved in 'omics' experiments [2]. In multidisciplinary teams, these users carry out omics experiments and seek biological meaning in the resulting huge, complex datasets. This results in dynamic, diverse sequences of interaction tasks. The *e*-BioLab continues to evolve towards a finished facility, partly based on experiences in everyday, real-life use.

Currently, the large display (3x2m) in the *e*-BioLab is controlled by an operator. His role is to follow the team's discussion and to fulfil visualization requests for the team. These requests can be implicit, in which case the operator will act on his experience, and explicit, coming directly from the users. Our observations so far show that explicit requests vary from visualizing particular data, to highlighting a correlation between data views, to applying data manipulation.

### Capturing User Behaviour during Interactions

Interaction tasks can be classified as either navigation, selection or manipulation. Clearly, these tasks can be subdivided further. We propose three consecutive

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user studies that provide more insight in naturally occurring behaviour when performing interaction tasks with a large display. This behaviour will be new because the interaction is novel itself, especially with human behaviour as input.

*First*, we observe microarray analysis and interpretation in *e*-BioLab meetings. An extensive task analysis of those meetings is currently being performed. Multiple audiovisual streams are recorded in the *e*-BioLab, combined with frame-based logging of its large display. Human behaviour in this footage is annotated with an emphasis on users' gestures towards both each other and the display. For annotation, we use an expanded notation for sign language [3] that includes the gesture's target, for example, in deictic messages. The resulting repository of gestures describes human behaviour, with an emphasis on gestures, that were clearly used to say something about, or have something to do with, the display.

*Second*, we perform a so-called Wizard of OZ experiment: users have the feeling that they are operating the display themselves through both explicit commands and gestures. The operator responds to these commands depending on their context, using our instructions. These observations are crucial for our goal. For natural single-user gesture interaction, gestures have to be both sufficiently recognisable and distinct from each other. For multi-user situations, there is an supplementary requirement that gestures made towards team members can be distinguished from gestures intended to operate the display.

*Third*, we introduce an automated gesture recognition system. Ideally, such a system is based on unobtrusive detection. Its aim is to polish our previous findings and to arrive at a robust, stable system. The current state of the art in such systems makes it unclear if a somewhat obtrusive solution must suffice [1].

### Discussion

We have described a method to arrive at a natural, multi-user gesture repertoire for HCI with large displays. Even without the third experiment, we will have constructed a significant gesture repertoire that life scientists can use to operate a large display. Porting our gesture repertoire to other user communities requires further investigation. However, we believe that it can be generalised to empirical scientists in general. They carry out tasks that are highly constrained by both their task environment and their explorative research approach.

## References

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