Object-Focused Interaction in e-Social Science

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Abstract. Distributed scientific work is receiving widespread attention from computer science developers within the e-Science programme. With notable exceptions less attention has been paid to how, in practice, collaboration support across the grid might play out in everyday scientific and analytic work. Drawing on a specific thread of research in Computer-Supported Cooperative Work we note how models of scientific work ignore the communication of work with digital artefacts such as presentations of data. We describe our initial attempts to support one particular form of distributed analytic practice – the freeform visual annotation of video materials – as part of the VidGrid project. In undertaking such support, our initial trials of visual annotation indicate that a reconsideration of the distributed science paradigm must take into account the concept of Object-Focused Interaction; that is, the relationship between body, interaction and data objects of mutual interest.

Introduction

Concepts of collaboration in e-Science have taken a number of forms, including the development of ontologies of scientific process to form workflows that structure collaborative work [1], or the use of multiparty video such as with the Access Grid to enable remote meetings with data visualizations and presentations [2]. E-Science's strengths lie in creating exciting new paradigms for computing, yet in providing access to services 'on the ground', many developers have been isolated from or at best simplistically informed about everyday scientific practice. In the main, the resulting interface developments that wrap complex yet important e-Science middleware embed broad-brush notions of scientific collaboration. Such notions may jar with day-to-day use and prevent significant adoption by the very communities they target. In this paper, we wish to address one such notion, that of how (social) scientists work with analytic artifacts such sequences of digital video, text or related materials.

Co-present situations often require working together with a variety of media, such as physical documents and digital materials displayed on screens. Such situations provide the ability to annotate, animate, share, juxtapose and mutually refer to a variety of information. Studies of work in a variety of domains including science and medicine [refs], workplaces [refs], and experiments [refs] highlight the subtle ways in which collaborators are able to convey their

expert perspective on an artefact, rely on others' ability to see and understand their behaviour, and to respond to that sequence in demonstrably subsequent ways [REF]. The practices involved in pointing at, pointing towards, imitating, showing and exaggerating features of interest for others are complex, but all draw on the assumption that they are potentially intelligible to (perhaps groups of) people for whom they are designed.

Communication between remote parties has typically rendered the subtlety and pace of such co-present behaviour problematic. Instead, successful remote communication systems tend to support reduced forms of interaction, such as text chat, telephone conversations or videoconferencing meetings. Over the past decade, research has attempted to extend and combine such technologies to support more subtle forms of behaviour, with varying success. If we consider the latest incarnation of real-time collaboration support over the grid, many would identify the Access Grid as an important tool, as indeed it is becoming for conducting remote meetings, presentations and so on. However, if we consider the use of Access Grid Nodes (AGNs) to support expert analysis of data between remote sites, problems start to emerge. We might transmit both video of the analyst(s) and visualizations of the data under scrutiny to remote co-participants, but without more explicit representation of analysts' mutual orientation to one another and their orientation data at a remote site, the ability to co-produce these forms of analytic behaviour is undermined. Many designers presume that the structured delivery of information displaying remote users (e.g. video streams) and remote data (e.g. distributed PowerPoint or data visualisations) will be enough to enable seamless collaboration between all participants with that data. Such designs assume that simple conversational meetings or presentations can occupy the same requirements axis as any other form of collaboration. Our emerging studies of technologies to support data sessions [REF] indicate that despite the emerging success of the Access Grid, more subtle and complex forms of collaboration are required to conduct qualitative (social) scientific collaborative work. Specifically:

- **Metadata needs to represent analytic process as well as its result.** Work with data across AGNs *remains largely 'in the world' and outside the Grid*. To sustain an understanding of the process of distributed analysis over time, it is necessary to find ways of recording realtime annotations such as references, embodied imitations and so on. The conduct with which analysts indicate and characterize sequences of interest to one another form an important part of the lifetime of qualitative data from collection cradle to paper grave. Thus, whether collaboratively arriving at a coding scheme, or producing an account of naturalistic data, annotation needs to include real-time reference in addition to standard metadata.

- **Relationships between analytic activity and data need to be transmitted.** Such analysis requires that participants have access to one another's activities *with respect to the data*. Researchers can have difficulties reconciling alternative viewpoints and perspectives on action, perspectives which are key to developing joint understanding. Juxtaposing video of participants and dataset visualization is a simplistic approach which fragments the relationship between analyst and data. Such a separation can generate significant difficulties in communicating and interpreting insights. Not only does it become difficult for an analyst to design references to the data for both local and remote participants, it is also difficult for those participants to implicitly display that they can see and understand such references in a way that allows the interaction to continue unarticulated. Furthermore, as noted above, reconstructing a sense of the analytic process requires that such relationships are preserved in recordings of analysis.

Thus, if we consider the use of AGNs to support such analysis, without more explicit representation of analysts' orientation to one another and the data at both local and remote sites, the ability to produce these forms of analytic behaviour is undermined. Here, we draw on previous work within the CSCW community to suggest that there are existing forms of distributed interaction design which attempt to take into account the preservation of these relationships. Such attempts form a thread of research which aims to support groups of users with and around mutual objects of interest in a variety of remote communication forms, from media spaces [4], through multi-user virtual reality [6], to remote embodiment through robot proxies [5]. In each case, an argument has been made that preserving object-focused interaction across sites remains integral to supporting the work of participants in those studies. We would argue that the subtlety of everyday analytic work, particularly in qualitative social sciences with which we are concerned, provides a key instance of this form of participation.

To apply a specific example to these issues, within the ESRC's VidGrid project, we are investigating how to support social scientists in distributed collaborative analysis of video data. The current interface for our system is shown in Figure 1. More details can be found on the VidGrid system elsewhere (Fraser et al. 2005). Here, we describe our initial attempt to support co-located data sessions, and arising issues. Our prototype system attempts to meet the needs of transmitting real-time metadata and data-activity relationships based upon the use of distributed projected interfaces and 'Mimio' electronic whiteboard marker pens [7] for annotation of the data. The use of the electronic whiteboard markers has been motivated directly by the need to generate real-time annotation over the video data with which our social scientists are interested. Furthermore, in providing the ability to refer to data by drawing on the screen, we hoped to encourage analysts to be gesturally explicit about their perspective on the data, as part of the communication to remote experts. In this way, the analyst's realtime relationship to the data forms part of the communication, and thus the articulated communication can be captured as metadata without imposing additional load on the participants.

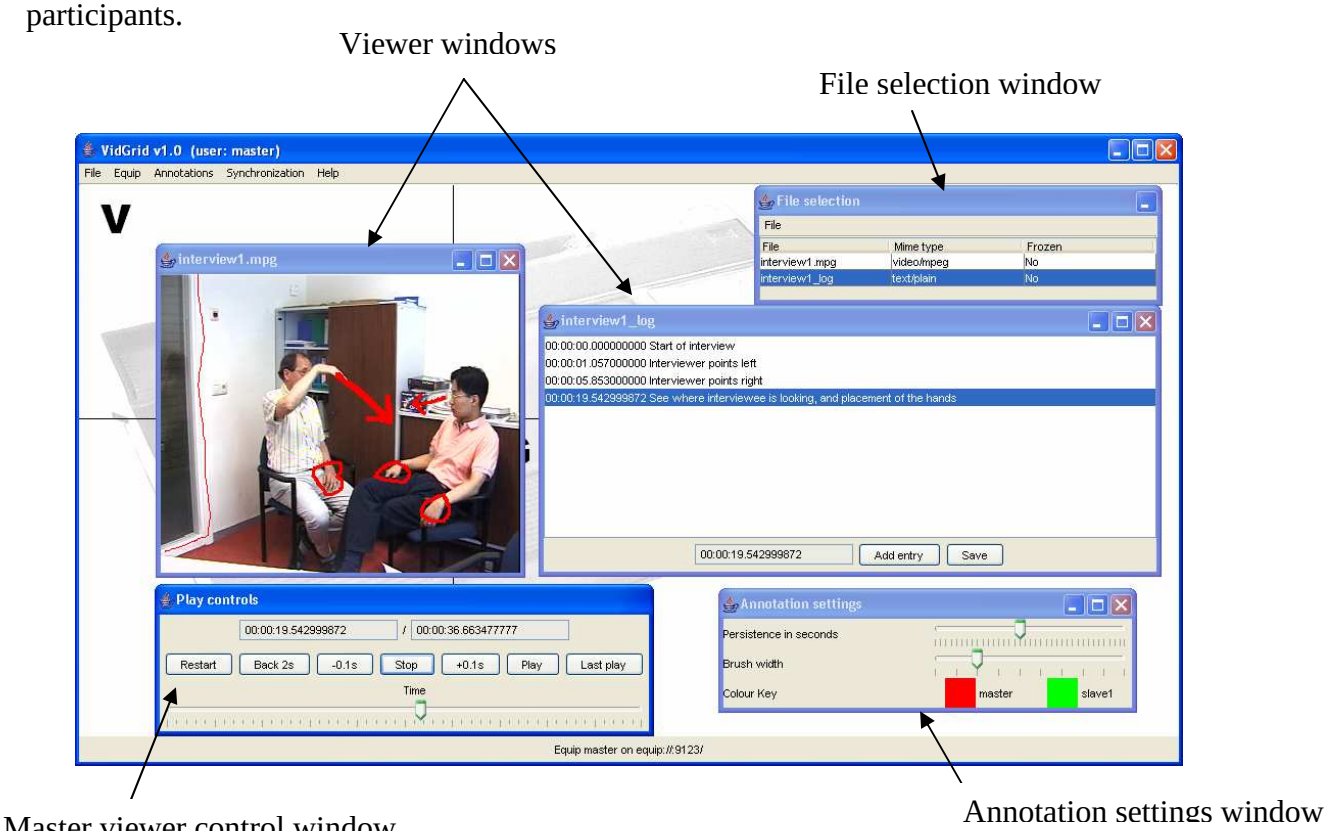

Figure 1. VidGrid Interface

However, our initial studies of data analysis sessions show that analysts do not only point to screens to indicate a feature of interest. Rather, more complex forms of analytic activity are demonstrated, in which imitations and exaggerations of features of the observed behaviour in the data are used alongside more explicit deictic references to that data such as pointing. Our initial experiments with transmitting video data have shown that whilst realtime annotation is supported by our current prototype, a pen-based approach makes it difficult to address both co-analysts and data simultaneously, and support for more detailed, expressive annotation is required, reducing the spatial tie between screen and analyst.

We propose that there are significant benefits to be gained by rendering data of the relationships between embodied activities and the local environment to be used in the remote representation of activities. In the case of distributed teams working with projected interfaces, such data might be obtained through the use of wearable location and orientation sensors, tracked mobile tools and/or contextual information or image processing (e.g. flow field analysis) on the local relationships between body and physical objects or data representations. Such devices at least provide the possibility that the display of these relationships might fit more closely with the distributed production of object-focused analysis in e-Social Science.

This paper has outlined parallels in object-focused interaction between current e-Science technologies and remote problem solving in distributed CSCW systems. Sensor and image processing systems provide promising avenues to embed the embodied practices of data analysis into the remote representation of analytic activities. More generally, it is suggested that such technologies offer opportunities to embed remote embodied practice into distributed interfaces, but that such additional representation needs to take account of how such embodied practices relate and are related to the local environment in which they are produced.

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