A Prototype Augmented Reality Collaborative Process Modelling Tool

Erik Poppe[1], Ross Brown[1], Daniel Johnson[2], Jan Recker[1]

[1] Information Systems Discipline, Queensland University of Technology, PO Box 2434, Brisbane, Qld 4001, Australia
[2] Computer Science Discipline, Queensland University of Technology, PO Box 2434, Brisbane, Qld 4001, Australia
{erik.poppe, r.brown, dm.johnson, j.recker} @qut.edu.au

Abstract. Identifying, modelling and documenting business processes usually requires the collaboration of many stakeholders that may be spread across companies in inter-organizational business settings. While there are many process modelling tools available, the support they provide for remote collaboration is still limited. This demonstration showcases a novel prototype application that implements collaborative virtual environment and augmented reality technologies to improve remote collaborative process modelling, with an aim to assisting common collaboration tasks by providing an increased sense of immersion in an intuitive shared work and task space. Our tool is easily deployed using open source software, and commodity hardware, and is expected to assist with saving money on travel costs for large scale process modelling projects covering national and international centres within an enterprise.

Keywords: Collaborative Process Modelling, Augmented Reality, Collaborative Virtual Environments

1 Introduction

Traditionally, in process modelling, modelling method experts have to consult with many of the people involved in the modelled business process (the so-called domain experts), in order to create an appropriate, complete and clear representation, usually in the form of a diagram that is constrained by a process modelling grammar [6]. Although there are many modelling tools and a variety of grammars available to assist this process, none of these are easily understood and used by anyone but the modelling method expert.

In multi-national corporations or in inter-organizational supply chains, many of the processes that need to be modelled, improved and/or automated, span organizational or even geographical boundaries. As a consequence, the required method and domain expertise is often geographically dispersed, making one-on-one sessions or even process modelling workshops hard to schedule, increasing related costs significantly. These challenges, in turn, demand appropriate technologies to support remote collaboration for process modelling [3].

To provide advanced support for collaborative modelling, software prototypes have been created by industry in an effort to increase user involvement. The SAP Gravity[1] prototype, for instance, uses Google Wave to create a web based collaborative process modeller. Similarly ORYX[2] is a process modelling tool that runs in a remotely accessible web-browser. However, these implementations typically only provide a web-based modelling environment, with limited actual collaboration features that would improve task-based collaboration, e.g., in terms of communication, decision-making, immersion or task support [7]. Partially, this lack of technological support is due to limitations of input and output devices that separate the task space, where artefacts of collaboration are located, the work space, where the work is done and the communication space, where participants communicate with one another.

Recent work has shown that *Collaborative Virtual Environments* (CVE) and *Augmented Reality* (AR) interfaces can overcome many of these shortcomings and allow for more effective collaboration, especially in areas that collaboratively generate artefacts or that rely heavily on communication, such as design or management [4]. A major benefit of CVE is the representation of space and spatial relationships [2]. These factors are important for communicating by body language, gestures, gaze and other means that depend on the spatial relationships of users and objects. AR systems aim to combine the real and virtual world seamlessly in three-dimensional spaces and allow for real-time interactions [1].

In our research, we are exploring the application of CVE and AR technologies to the task setting of collaborative process modelling. To that end, we firstly developed a prototype process modelling system within a collaborative virtual environment [3] and, secondly, implemented appropriate AR technology. Our prototype tool merges a typical process modelling work space, with a networked AR interface, to facilitate the collaborative modelling process even further than the use of a virtual environment alone. We believe this innovative prototype opens up many possibilities for improving the approach taken in remote process modelling, by providing an interface suitable to the task of concurrent remote collaboration, and also serves as an important vehicle in process modelling research, where the effects of advanced collaboration features on the process and outcomes of collaborative modelling can be examined under controlled conditions.

In the remainder of this demonstration paper, therefore, we describe important components of the AR collaborative tool, and report on some of our initial application experiences. We conclude with presenting ideas for further design work as well as implications for research on the basis of the developed tool.

2 AR Collaborative Tool Components

Our prototype AR modelling system brings the process model and representations of the remotely located participants into a real space, to allow for natural interaction with

[1] Gravity – http://www.sdn.sap.com/irj/scn/weblogs?blog=/pub/wlg/15618
[2] Oryx – http://bpt.hpi.uni-potsdam.de/Oryx

both the model and the participants. This information does not just consist of written and spoken language, but also gestures, body language, spatial relations to other people or parts of the model and gaze. From literature examined previously [7], we conclude that this prototype should use avatars to represent remote participants in order to facilitate this gestural communication.

2.1 Augmented Reality Second Life Client

A video-see-through approach with a web-camera and a Head Mounted Display (HMD) was chosen for the prototype, since it can be implemented with commodity hardware (refer to Fig. 1, right hand side, for the equipment worn by the user). For the image generation component of the system, it was necessary to modify the rendering and camera processes in the Second Life client program. For this prototype, a plugin was developed to intercept the draw command stream that is sent to the OpenGL driver by the Second Life client for rendering the scene and to implement the marker detection, camera manipulation and background scene removal stages required to provide the AR capabilities [8].

2.2 Collaborative Process Modelling Tool Features

It was decided to modify our existing collaborative process modelling prototype which we introduced and evaluated elsewhere [3]. The modelling system works by using a pool of tiles. Users can fill a pool with tiles for modelling by sending a text command with dimensions to the pool object. Users can then move around the tiles and change their appearance to represent diagrammatic constructs from the BPMN grammar.

The modelling tool provides a selection of 65 different constructs from the BPMN specification. Users can edit a tile by double-clicking. The tile will then pop up and display a selection of constructs on its sides (refer to Figs. 1 and 2). To make the tasks readable from any angle we have the task name drawn as floating text that always faces towards the viewer. As an aid to drawing attention to particular elements, when a user single-clicks on a tile, it is highlighted in red, making it visible to all participants.

2.3 Tool Maturity

The system presented in this demonstration is a research prototype. In its present form, its key application area is that of a sketch collaboration tool when discussing a BPMN diagram. Most of component types in BPMN diagrams are implemented, and so real processes can be modelled. However, some more complex components, such as embedded sub processes, have not been implemented at this point in time. The process models are persistent in the virtual world from session to session, but cannot, at this stage, be exported to other process modelling tools. Finally, avatar functionality is reduced in the immersive view of the environment, but is easily modified, and will be fully functional in a released form of the tool. We aim to release the prototype as an open source project soon. Presently, the system works on Windows, but other

operating system versions can be easily built, as the major components are available on Unix style systems such as Linux and Mac OS X.

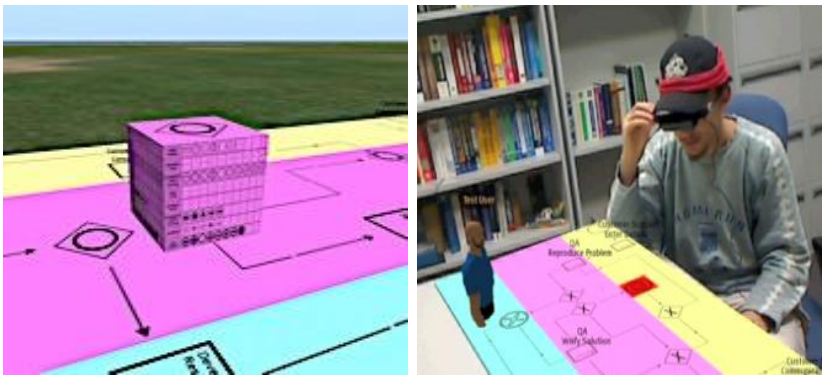

Fig. 1. Left Image – shows a magnified image of editing a popup tile, showing the menu options listed on the side of the cube. Right Image - illustration of a remote user (human avatar) editing a BPMN diagram and highlighting a diagram element (red square) to draw the attention of the viewer. Note the gaze of the avatar reinforces the intentions of the remote collaborator.

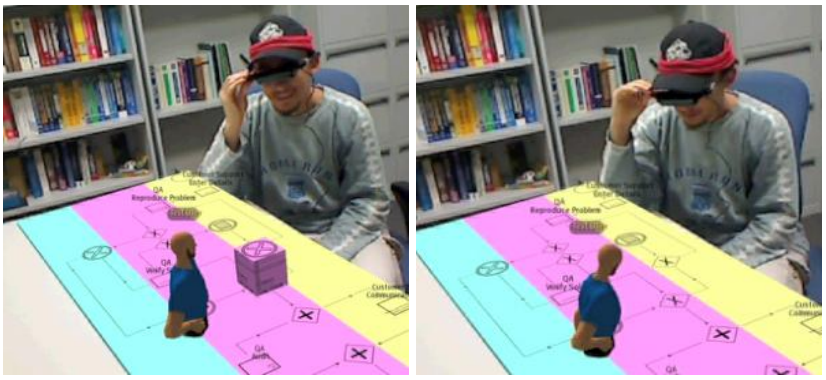

Fig. 2. Two images showing the editing of a process model element. Left Image - shows an element that has been double clicked by the avatar. Right Image - shows the result of choosing an element on the side of the cube, with the event icon substituted by a gateway icon.

We performed a preliminary evaluation of the tool with a cohort of five method experts. All reported positively about the intuitive AR user interface, remote connected avatars, immersiveness and audio chat capabilities. Some negative comments were addressed towards factors regarding the maturity of the prototype, such as modeller features, interaction limitations and the quality of the HMD. These maturity problems are tractable and are able to be fixed in future versions of the tool.

3 Conclusions

We have built a prototype remote collaborative process modeller using easily available CVE and AR technology. Preliminary feedback on the system indicates it

can indeed improve remote collaboration in process modelling by providing a subjective sense of immediate communication and deep immersion. The prototype shows good potential as a novel and effective way to improve remote collaboration in process modelling scenarios.

In addition, the system can be built at relatively low cost with commodity hardware (we used laptops) and open source software. It is therefore likely that savings in travel costs using such remote collaboration tools would easily outweigh initial costs in purchasing the software and training users. These findings suggest that AR collaborative modeling technologies can provide a viable cost-effective option for cross-national and inter-organizational process management initiatives.

Aside from the practical implications as a cost-effective alternative for inter-organizational process modeling, we believe the prototype also serves as a useful research vehicle to study, under controllable conditions, processes and outcomes of process modeling. Our prototype provides advanced task-based collaboration features (such as immersion, gesturing, live communication, real-time editing), the effects of which can be tested against a control group regarding the implications on the efficacy of the modeling process, or the outcomes of such processes. For instance, on the basis of our prototype, scholars can examine earlier tentative propositions voiced about learning facilitation, knowledge development and run time validation that are speculated as outcomes of technology-enabled collaborative modeling [5].

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