A Case Study of Remote Interdisciplinary Designing through Video Prototypes

Cristian Bogdan*, Dominik Ertl†, Jürgen Falb†, Anders Green* and Hermann Kaindl†

* Royal Institute of Technology, School of Computer Science and Communication
  S-100 44 Stockholm, Sweden
  {cristi, green}@csc.kth.se

† Vienna University of Technology, Institute of Computer Technology
  A–1040 Vienna, Austria
  {ertl, falb, kaindl}@ict.tuwien.ac.at

Abstract

Designing in an interdisciplinary context is challenging, and it is even more so when it has to be done remotely. For such remote interdisciplinary designing, we propose video prototypes as artifacts for supporting the interaction design process. In this paper, we present a case study where we have successfully used video prototypes for collaboratively designing a modeling tool. This tool is supposed to provide Dialogue Design Support for creating multimodal user interfaces. The new and important aspect of this case study was using video prototypes for joint interactive designing done remotely, and also between disciplines.

1 Introduction

Collaborative interaction design involves interdiscipli-

nary teams and should be supported by appropriate ar-

tifacts. Video prototypes are one type of such artifacts and facili-

tate communication through videotaped sketches for de-

monstrating interaction. The main rationale for the use of

any video prototype in collaborative design is that using reg-

ular prototyping methods, such as wire-frames, visual tools

for GUI development, etc, often fail to capture the overall

user experience because they focus on the user interface as

an artifact [13, 15].

The new question was whether such video prototypes

still be useful when the teams involved work remotely

and even in different countries, so that they become the key

artifact for communication. In addition, it was interesting to

see, whether and how this approach could support collabora-

tive designing between interaction designers and software

developers.

We investigated this question through a case study of de-

signing a complex modeling tool in the context of an EU-

funded research project. This design process has been en-

acted between the partner responsible for interaction design

and the partner responsible for tool development, where

these partners worked in different European countries. It

involved interdisciplinary negotiation in the course of inter-

action design, with the goal of achieving an innovative de-

sign that was still implementable in the given context. Video

prototypes were used as the key artifacts supporting remote

collaboration and interdisciplinary designing.

The remainder of this paper is organized in the following

manner. First, we provide some background on video proto-

types. Then we describe the context of our case study. After

that, we elaborate on several iterations of remote design col-

laboration making use of video prototypes, as it happened

in this case study. Next, we generalize from the concrete

case at hand and provide lessons learned. Finally, we dis-

cuss related work on cooperative design.

2 Background

Video prototyping [10] has been introduced as a method

to make concrete representations of interaction design in the

form of videotaped sketches on which interaction is demon-

strated and explained by the narrator. Compared with ordi-

nary sketches, video prototypes have the advantage that

they can capture the temporal dimension of the interaction.

In the following we describe what a video prototypes is and

where video prototyping is needed.

2.1 What a Video Prototype is

Video prototypes are representations of interaction de-

sign that use the video medium to record and convey design
ideas. In being prototypes, they focus on the design statement rather than on the quality of the video, which makes them unusual video productions. Video prototypes are often a series of sketches drawn by hand and filmed in one go, with no double takes and no cutting, with the audio track being used for explaining and commenting on the interaction envisaged. After a bit of training, rapid production of video prototypes allows the designer to explore the design space rapidly, without having to think of the video technique. The ease of importing video into the digital form in recent years has made video prototyping even more attractive for expressing and documenting interaction design ideas.

Mackay [9, 10, 3] has emphasized the role of video in design exploration, and idea generation (video brainstorming) already in the late 1980s. Mackay introduced video prototypes in the wider context of participatory design [7], where users and developers are co-present with designers at the video prototyping sessions. As in most participatory design contexts, the participants learn the design techniques like video prototyping and are able to express their ideas using the method learned. The prototypes are kept on record for future reference during the design process, and it is typically the designers who keep them and consult them often. Westerlund [16] has also worked with video prototypes in the participatory tradition and has elaborated on the leading role of the designer in such contexts.

In principle, video prototypes can be helpful artifacts to study all technical activities where humans are involved. However, in our case study we used video prototypes to document interaction design where different stakeholders are involved. So, the content of such a video prototype is interaction design from a stakeholder’s point of view. This stakeholder (one person or a group of people) documents with spoken text how she defines and understands the according interaction with a tool. The designed interaction is informal and allows any techniques or wording that helps to better understand the interaction and to achieve a middle ground between the collaborating partners.

The output artifact in the collaboration process is a final video that prototypes the interaction design for a given application with additional background documentation of the domain and the iterative prototyping process. This video is the middle ground of the stakeholders and shall be used as a basis for the design and implementation of the tool. So, the video has to clearly show how a human and a machine are interacting with each other, which actions are performed and what content they are communicating about.

Documenting the (paper) sketches via speech-supported video improves the quality of the interaction design. For the editing itself, the stakeholders can use any open source or freely available video editing software.¹ So, video prototyping comes in different variants, one type is showing the “grand vision” of some kind of novel user interface. The “Starfire” video prototype is an early example of such use of video prototyping [13]. This type of video prototypes show a certain type of “future use”, a smooth and flawless vision of how an interface or interaction situation would unfold.

Nevertheless, for using sketches at the different stages of the prototype creation, some techniques were proposed in [15] that should be considered: use story boarding to create a narrative structure for the video prototype; cut out animation, where objects are moved in real time in the view of the camera or other simple animation techniques for real-time animation can be used (i.e., using hidden magnets to move objects on a screen); cell animation, which is commonly used in making animated movies, is a somewhat more time-consuming technique, but can be useful to illustrate key elements of the prototype. Cell animation can be done using hand-made sketching, physical models or other imaging tools such as presentation-drawing software or 3D software.

There are risks, however, such as the issues involved in portraying characteristics of a specific software product (e.g., look-and-feel of an operating system) [15]. Another possible problem as noted in [13] is that the whole project portrays a kind of fantasy that cannot be implemented. When it comes to how the users perceive the prototype shown in the video, people might think the system shown is the real system.

Several authors have noted that the video creation process can be time and resource consuming to the expense of the overall project [8, 13, 15]. Thus, there is a need to find a compromise between the power capacity of showing a vision for the future and actually being able to create a video prototype before that future arrives. This leads to another approach for video prototyping that involves using video as a means of representing a usage scenario [8, 10]. This variant of video prototyping has the goal to make concrete representations of interaction design in the form of videotaped sketches on which interaction is demonstrated and explained by the narrator.

2.2 Where Video Prototyping is Needed

Video prototypes relate well to the scenarios that may be used in design, as several prototypes can be made for a certain scenario. It is one of several approaches to support the creation of scenarios. Scenarios allow designers and users to form visions of a possible future product. Bannon [1] phrased this as “users need to have the experience of being in the future use situation, or at least an approximation for it, in order to be able to give comments of the advantage

¹e.g., the Windows Movie Maker http://en.wikipedia.org/wiki/Windows_Live_Movie_Maker
or disadvantages of the proposed system”. Using scenarios that involve design of “future use” also implies that the design process starts from the praxis of future users. Such praxis arises from what can be characterized as a “conflict between current use and demands from external forces” [2].

Video prototyping generally assumes a co-located group of designers, users and developers producing a number of prototypes together as a form of documenting the interaction design. Like for any form of prototyping, it is important that the participants focus on the interaction design ideas prototyped, not on the prototyping technique [3].

In the case of designing a tool, an expert on human-computer interaction might study how people work with comparable tools and what their interaction preferences are. In contrast, a software developer is mainly focused on the technical aspects. The UI designer might be interested in the concrete implementation of the GUI, where to place the buttons and text fields and how to achieve network communication. Here, video prototypes are very helpful to better understand each other’s position — especially when stakeholders are working remotely, a quite typical situation in today’s research and development projects.

The video-based approach relies on sketching and works as a means to reason about, communicate, and persuade others [8] of the ideas expressed and manifested in the video. As being a type of asynchronous design method [14], video-based prototyping allows designers and developers to form heterogeneous teams to develop ideas across organizational, temporal and social boundaries.

The concrete video artifacts can also be used as milestones to step back to prior revisions if the prototyping leads in an undesired direction. Moreover, the artifacts can be used as project results even at an early phase of a project. This is helpful when the project plan includes (formal) requirements or milestones for such results.

3 Context of the Case Study

Our case study has been performed in the context of a research project involving partners from several European countries. Part of our work was designing and implementing a multimodal UI of a semi-autonomous mobile service robot. Here we used a novel approach with Dialogue Design Support to semi-automatically generate the user interface out of a high-level interaction model.

A success criterion for the design support features was defined as to what extent they allow modeling human-robot interfaces.

We set out to design a tool that would help a modeler to design multimodal dialogues. This interaction design work started with a number of premises:

- Generic requirements are weak in expressing interaction design. A technique that would work with concrete representations of interaction was necessary to achieve common ground within the interdisciplinary consortium, especially between partners specialized in interaction design and partners specialized in software engineering. Therefore, we chose video prototyping [9, 10], a technique that our designers were experienced with to design anything from graphical user interfaces to multimodal robot interfaces.

  - Another specificity of the design situation was that a modeling tool existed already as shown in Figure 1, yet it was not targeted at a modeler audience, in that it required a combination of interactive tools with authoring XML-based scripts. Furthermore, the tool was lacking interactive modeling facilities. The pre-existing tool in Figure 1 supports a modeler to create dialogue models in a graphical manner that capture the interaction between two parties (usually between a user and a machine), but the tool lacks design support for modeling interaction through specific modalities humans use for interacting with a robot, e.g. GUI, speech, and gestures.

  - We had to carry out the interaction design work in a distributed design work situation, spread among two locations (Sweden and Austria). Therefore, it was important to work on achieving common ground, and to use concrete artifacts during design, hence the choice of video prototyping.

  - We also were in a multi-disciplinary work situation, in that one location was focused on users and interaction and the other location was focused on modeling language and tool development. We were aware that a ‘gradient of resistance’ [4] exists from the developers in such situations. This made the grounding of the design ideas over the whole distributed team even more important.

4 Remote Collaboration in Design via Video Prototypes

In this given context, we had to collaborate remotely in the course of interaction design. Our case study focused on the use of video prototypes facilitating this process.

More precisely, our work employed video prototyping in a distributed setting, where project partners from various disciplines worked at different locations and did not meet physically for long periods. Along with documenting the interaction design, the prototypes also had a role in the dialogue between disciplines in that each video prototype sent to the other partner was not only a documentation of progress but also a statement made in a negotiation process.
For example, a prototype sent by designers can communicate “we would like this feature” while a prototype sent back by developers makes a statement that “this is what is feasible to implement”. Throughout, the two sides learned from each other: developers learned and applied (with various adaptations) the video prototyping technique, while designers learned the technology constraints. Both sides developed together knowledge about the features that should be offered to the dialogue modeler using the resulting tool.

We can thus view our approach as a negotiation via video prototypes. The interaction design partner created some provocative video prototypes, and shared them via the Internet. The prototypes constituted a basis for computer-mediated discussion, and it was easy to refer to certain details in the prototypes by referring to the video-clip time. Based on these discussions, the tool-development partner was asked to respond with prototypes that express what can be implemented within a reasonable timeframe. The dialogue achieved a form of grounding between the partners, and based on that common ground we were able to select the interaction design ideas for a Dialogue Design Support tool which are of highest value to the project.

4.1 First Design Iteration

The first iteration in our process was a video prototype sent by the interaction designers, which started from the initial dialogue modeling tool in Figure 1 and proposed improvements to it. The existing tool was first shown as a screenshot, to ground the current situation, then the prototype switches to a sketchy representation of the same tool (Figure 2, left), in order to disconnect from the presently implemented tool and encourage occurrence of and trying out new design ideas. The video prototype introduced the idea of creating a navigation map out of the dialogue model, and to illustrate the navigation map along with the dialogue model (see the leftmost part of the left sub-figure in Figure 2). The navigation map had been discussed by the two collaborating parties previously and it was regarded by the interaction designers as crucial for the users to get an overview of the interaction, as a complement to the overview provided by the dialogue model.

The prototype also suggests showing a corresponding graphical user interface (GUI) at the same time as the dialogue model, and illustrates the correspondence between various panels in the GUI with various sub-trees in the dialogue model. This is termed as “model correspondence” and is reinforced with a text bullet in the video prototype. Such correspondence is important in the area of modeling tools because the abstract models will often be far from a “what you see is what you get” situation, therefore the correlation is needed to help the modeler learn about the interface rendering process.

While the new concepts introduced by this prototype
would allow the modeler to understand and control better the process of generating and adjusting a user interface, it still did not cover well other modalities than GUI. The video prototype then goes on to illustrate another interaction approach which was based on the navigation map. Each state in the map was presented with its communicative acts (model sub-tree), and transitions between states were automatically associated with each communicative act. The concept of communicative acts is derived from speech act theory [12]. Each state was shown with its corresponding GUI dialogue but also with the modalities in which all communicative acts could be uttered. This prototyped variation of the interaction was thus focused on the navigation map, and attempted to explore the interaction possibilities that appear once the navigation map takes such a central role in the interaction.

Most prototypes make a statement, and in this sense the first iteration prototype stated that modeling tools need to be enhanced to provide overview, especially in regard to navigation. Like it often happens in design, alternatives were presented: two ways of presenting the navigation map were shown, of which only the second covers the multimodal interaction case.

4.2 Second Design Iteration

Together with the first video, another message was conveyed to the developers as to how facile it is to make a video prototype. The practice associated generally with video is that of careful planning, scripting, taking multiple shots of the same scene, cutting, adding soundtracks, etc. The statement made by interaction designers at this point was that one has to renounce on the “quality video” approach and regard the video as a sketching tool, and that it would allow playing around with interaction design ideas rather than focusing on producing a video in the professional sense. Some specific techniques of using paper, post-its, transparencies, trying to film a scene just once, etc., were also conveyed in the same spirit of illustrating easiness of video prototyping and of encouraging the developers to take up the technique.

The developers were receptive to this and, as they did not agree on how multimodality was supported in the first video, one developer made a prototype where he expressed his interaction design ideas (Figure 2, right). As he was responsible for the multimodality part of the Dialogue Design Support, the developer aimed to present an approach that would be reasonable to implement within a given timeframe in the project. The prototype introduced the idea of annotating communicative acts with the modalities in which they can be uttered. The video was strongly grounded in the existing modeling tool, so it was presenting sketches that were placed on various parts of the tool, thereby being careful not to depart too much from the existing implementation. The prototype was, on occasion, confronting the modeler with XML files that had to be written within the tool for the
multimodality modeling. Also state machines expressed in UML format were to be exposed to the user of the modeling tool.

While the prototype of the second iteration was received by the interaction designers as a positive development, it was clear (and not unexpected for a first video prototype made by the developers) that the prototyping technique was too much in focus and that the reluctance to depart too much from the existing implementation was hampering the introduction of radically new ideas. The XML authoring or state machine modeling, while easy to implement, were hard to accept considering a non-programmer modeler who would use the tool, but the rationale for proposing it was understood by the interaction designers.

4.3 Third Design Iteration

The third iteration consisted of remote discussions between the two sides, trying to achieve a middle ground between the designer prototype and the developer prototype. The navigation-centered interaction paradigm as proposed by the interaction designers was considered an interesting new approach but hard to implement given the technical infrastructure available, and alternatives were preferred. Alternatives were sought for the XML editing proposed by the developer. It was also recognized that the developer prototype was too much grounded on current realities, but it was also agreed that the implementation at the time could not be changed radically due to project constraints.

The video prototype proposed the following resulting design elements:

- An interaction design centered on the navigation map: instead of the map being shown on the side as in Figure 2 (leftmost part of the left sub-figure), the interaction designers played with the idea of having large navigation map states, inside which renderings of the GUI can be shown (Figure 3). Each rendered widget is associated with the corresponding dialogue model’s communicative acts shown at the bottom of the state, with the model correspondence design principle in mind (correspondence between a widget and its communicative act).

- The modalities for each communicative act that can be uttered in the respective state are also modeled as annotations to the communicative acts.

- Fusion between modalities can be modeled by using modality combinations like speech+GUI to express, e.g., “Go” in speech and indicate the location (of a product in the context of a supermarket) on a touchscreen.

- Links between navigational map states are emphasized by arrows starting on the communicative acts that lead...
to the state transition.

- As the states that show rendering inside it are large, the interface needs to scroll when a state transition is triggered, as shown in Figure 4.

- This prototype also introduces the idea of recording corpora while the user interface generated with the tool under design is running.

During prototyping, we learned that in the GUI modality some of the communicative acts are already uttered by the time the GUI dialog is shown (displaying a widget corresponding to an Offer effectively means that the Offer was uttered). These already-uttered communicative acts should be shown in a different color in the Dialog Design Support tools.

### 4.4 Fourth Design Iteration

As a result of the remote negotiation in the third iteration, the developers proposed the fourth and final prototype of this case study. The prototype was made by the chief developer, who had an overview of all implementation aspects. While the aim was to produce a video, the medium chosen was not paper but a slideshow in a presentation tool. As he was fluent in using this tool, the prototype author could focus on the prototyped ideas rather than needing to focus on the prototyping technique. The prototype is illustrated in Figure 5 through a GUI mockup based on the initial tool screenshot and extended in a graphics tool. From the first prototype it adopts the idea of showing a navigation map, yet it does not adopt the interaction paradigm centered on the navigation map. A rendering to GUI is also shown at the bottom of the figure, and the correspondence between the model elements and the GUI widgets is shown as suggested by the first prototype. For example, in Figure 5 the corresponding elements communicative acts, generated GUI, and the state in the navigation map circled in red are illustrated. In contrast to the third prototype, the rendered GUI is not presented within a state of the navigation map by the developer due to expected implementation difficulties. This correspondence between user interface, modeling, and navigation map elements has been animated in the slideshow to get a glimpse of the intended behavior and interactions.

Annotating communicative acts to support multimodality is adopted from the second prototype and represented by checkboxes to select the supported modalities (see Figure 5, bottom center). The video prototype also showed in further slides possible representations of communicative acts for other modalities like speech.

The recording of dialogues to form a corpus was adopted from the third prototype. A tool for generating a large number of possible dialogues was also added based on discussions in the third iteration. Figure 6 shows a small excerpt of a list representing sequences of possible dialogues that result from a designed dialogue model. This video prototype
thus served well to achieve a middle ground between the two collaborating partners and was accepted by both partners as a good result for this design process. Both partners agreed that the most important features for supporting dialogue design have been included in the final prototype. The partners negotiated a compromise for representing these features within these four video prototyping iterations.

5 Lessons Learned

Let us generalize from this case at hand and state a few lessons learned. First, it was easy to create video prototypes even for those not experienced. This makes video prototyping suitable for such interdisciplinary processes. For example, the video prototype of our second iteration was the first one produced by the developer in charge of multimodality, and he invested only little time following basic tips from the designers plus the example prototype from the first iteration. Of course, designers have to encourage developers to engage with one of their techniques in the course of the design processes.

Our second lesson learned is the following. As long as all the participants involved can both understand and create such video prototypes, this can help to bridge different disciplines. Finding a common communication language is crucial for the discussions and negotiations between disciplines. The experience gained in this case study suggests that video prototypes can indeed serve this purpose. However, even though the interaction designers and the software developers in this project came from different “cultures”, both in terms of disciplines and countries involved, all of them have in common that they are researchers. This may have facilitated their understanding and their ability to create such video prototypes.

Third, video prototypes are useful artifacts for remote design negotiation, based on the experience gained in this case study. The compactness of these video design statements is suitable for a remote design setting. A video of 5-10 minutes can package a lot of interaction design material to be discussed online. Working with videos remotely is also facilitated by the ability to refer to different time slots in the video and rapidly flipping through it.

Fourth, this case study also showed that video prototyping can be an efficient starting point for creating interaction models, since its main purpose is to convey the intended interactions a user executes with a machine. Thus, as a side effect, we have seen that these video prototypes are also a very helpful starting point to derive initial dialogue models from them.

Fifth, like any kind of prototyping, video prototypes help stakeholders to achieve a common understanding of a design. While this is true for our prototyping process, the
video prototypes presented here have several specifics that are not commonly associated with such prototypes. Each of our prototypes was made by people from one single discipline (designer, developer). In addition, the participants were not co-located. Finally, the participants had a dialogue through sending out the prototypes (and not a dialogue while making the prototype as it is generally assumed).

We therefore wish to emphasize the asynchronous prototyping [14] values of the video prototypes, as well as their value in getting designers and developers who cannot meet for objective reasons to still collaborate closely around interaction design ideas. As our case study shows, such collaboration can include negotiation and other sensitive aspects that are usually associated with the need for co-location. Lack of co-location between disciplines has often led to developers retreating in an “ivory tower” and producing software without knowledge on how it is going to be used. Our experience shows that video prototypes may provide an easy way to break such a negative pattern.

It is important that people from different traditions and disciplines are able to adapt the language to their own existing skills, like the developer who went from a video prototype on paper to a video made out of slides in a presentation tool. The quality in regard to technique or design ideas for participants who are not used to video prototypes is not so important in the beginning, yet their engagement in the interaction design process is crucial for a productive interdisciplinary process. Due to its low-level prerequisites and ease of assembling a provocative prototype, we believe that video prototyping is suitable for attracting such developer engagement into the design process.

6 Related Work

Interdisciplinary work and the tensions between various disciplines in interaction design have been enduring themes in human-computer interaction. In requirements engineering, primarily textual specification is the traditional way of communicating between different stakeholders in a project. However, this traditional approach has shortcomings in regard to interaction design, as it is difficult to describe interaction details in textual statements.

Cooperative design [7] has been an early structured attempt to involve designers and developers (along with users) and let them participate from the early stages of the design process. Cooperative design combines stakeholders with different competencies and they get to learn each other’s concerns. They also learn about and engage with each other’s methods. Cooperative design thus creates a context where participants are viewed as partners who learn from each other. This is close to the approach we have taken here. Although users of the designed tool (potential dialogue modelers) were not involved directly in the process, we still regard it as a cooperative design activity between designers and developers.

In the context of the video prototyping for creating a vision of a future use scenario, Hi-Fi simulation techniques should be mentioned. Such methods for creating a vision of an interface involve the portrayal of an interface that can be experienced directly by the users. The most prominent technique for doing this is the Wizard-of-Oz method, that uses a simulation software to make users believe that they are interacting with a real implemented interface where, in fact, the mechanism and program logic behind the interface and the actions are controlled by a hidden operator [11]. In interaction design for human-robot interaction, this has been employed in [6]. Using a slightly modified variant of the Wizard-of-Oz technique that focuses on the overall experience of the scenario, a theatre-based human-robot interaction has been developed [5]. Instead of portraying an interface that can be directly interacted with, the whole scenario is shown using actors who play the part of the user interacting with a machine (e.g., a robot) that plays the other part.
The overall scenario is then watched by an audience that can express opinion and attitudes towards the scenario being staged, e.g., using standard usability assessment methods.

7 Conclusion

While interaction design is often a co-located activity, we show a case of designing remotely. The results from this case study indicate that video prototyping can be used successfully for collaborative design involving remote partners and between disciplines. To our best knowledge, such a use of video prototyping has not been reported in the literature before. While stakeholders have been co-present and working on the same video prototype in previous studies, we had the stakeholders distributed and doing one prototype each in successive iterations.

In particular, this work also shows how project partners concerned with software development can participate in the prototyping activities during interaction design. Several versions of video prototypes can facilitate the design negotiations with project partners concerned with the interaction design. The finally agreed interaction design of Dialogue Design Support for modeling multimodal user interfaces — again represented as a video prototype — comprised features that, thanks to the negotiation process, were both innovative and feasible to implement technically.

Acknowledgment

Part of this research has been carried out in the CommRob project, partially funded by the EU (contract number IST-045441 under the 6th framework programme), see http://www.commrob.eu.

References


