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Interactive Multimedia Storyboard for Facilitating Stakeholder Interaction

Supporting Continuous Improvement in IT-Ecosystems

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Abstract—**In order to stay competitive, elicitation and validation of user requirements are crucial tasks of a software system provider. However, reaching common ground among stakeholders and engineers is still difficult. In the special context of IT-Ecosystems, continuous improvement efforts call for non-standard requirements engineering methods. We propose a new kind of interaction between engineers and stakeholders that is based on multimedia technologies. Our interactive storyboard aims to facilitate stakeholder interaction and enable requirements engineering optimized for fast-paced situations with severe time limitations. Requirements and visions of new systems are documented in a multimedia representation. This representation is easy to create and requires no formal preparation for stakeholders to understand. Thereby, we aim to improve comprehension of requirements in stakeholder meetings and strengthen stakeholder involvement. The use of video, photo and audio acts as a catalyst for fast-paced stakeholder interaction.**

Keywords; Elicitation, Validation, Docmentation, Multimedia, Videos, Stakeholder Interaction, IT-Ecosystems

I. INTRODUCTION

We consider common comprehension of the documented vision to be mandatory for validation of the discussed requirements. Textual use cases [1, 2] and UML in general are widely used for customer interaction. Often, this entails a learning phase and may still lead to misunderstandings. The stakeholder may be hindered to express further requirements. Generally, the notation used by the engineer is expected to a) support engineers in eliciting stakeholder requirements and b) documenting requirements as complete as possible. Validation of both attributes build upon comprehension of the used representation on stakeholder side. This classic RE problem is intensified in the case of IT-Ecosystems: IT-Ecosystems (ITES) describe large IT-systems consisting of interacting and evolving subsystems and human agents. Prominent examples of ITES that are already integrated with our everyday life include airports or train stations. Users visit ITES in order to accomplish certain tasks and the ITES supports and automates the achievement of said tasks [3]. In order to stay competitive and evolve, development based on user feedback has been proposed [4, 5, 6, 7]. This entails several problems:

A passenger waiting to board a plane wants to accomplish this task quickly and does not want to be bothered with workshops or lengthy questionnaires. Eliciting requirements becomes a one shot opportunity, as this passenger will not be available for further questioning. The requirements engineer needs to complete several RE activities at once. Additionally, the passenger needs support in phrasing requirements in this situation easily and quickly.

II. INTERACTIVE MULTIMEDIA STORYBOARD

We present a new kind of dedicated multimedia storyboard. It focuses on direct interaction with stakeholders and employs several multimedia technologies for documentation of user requirements. Our main goal is to enable deep stakeholder comprehension without the necessity for learning a sophisticated notation. This empowers participants to interact and understand documented requirements. This goal can be divided into:

1. Enable the engineer to formulate requirements in a way the stakeholder can understand, thus creating a common basis for discussion.
2. Enable the stakeholder to express new requirements.
3. Capture and document the expressed vision as true to original as possible.

Our storyboard VisionCatcher supports the stakeholder in expressing the vision of a new system or an innovative idea for improving an already running system. Visions are depicted as a special kind of video, which are enhanced by multimedia technologies. In a meeting, the engineer constructs these videos in tight collaboration with the customer: Each action is depicted as a piece of multimedia (video-clip, photo, screenshot, hand-drawn sketch, and audio-clip). Actions are stepwise concatenated in order to form a so-called VisionVideo. This way, requirements are documented in an expressive and highly concrete representation. More so, these requirements can be *validated on the spot*: VisionVideos are watched together with the customer, enabling him to express feedback and corrections. Corrections are not limited to the interchange of depicted steps:

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The VisionCatcher allows individual user-driven annotation *directly on the shown piece of multimedia*. Newly arisen requirements and change requests can be documented explicitly. According to Schneider [8], findings of an interview must be validated as soon as possible. If discussion is delayed too long, stakeholders may not remember enough of the interview in order to validate the findings.

A. *The VisionCatcher Tool*

A first feasibility prototype of the VisionCatcher tool has been implemented by Ingo Kitzmann [9, in German]. The main screen of the VisionCatcher tool (see Fig. 1) is divided into three parts: the library (left), the filmstrip (at the bottom), and the main view (center). The example shows the vision of a new scanning system in a bibliotheca.

The library on the left shows all currently available pieces of multimedia. Describing tags are assigned to each clip. The little area marked with "Tags" (left, upper corner) shows the current selection of tags. The "+"-Button allows the user to add more tags to the selection: A window with all available tags pops up. In Fig. 1, only elements with the tags "Library" and "Book" are displayed. The VisionCatcher interface is optimized for use on a tablet computer. Most actions are done with a single "click" (touch of the pen) or "drag & drop".

On the filmstrip, (bottom of Fig. 1) the user arranges different pieces of multimedia to construct a scenario. The filmstrip metaphor is well established in entry-level video movie editing software and the order of the elements on a strip is easily associated with a chronological order - even by inexperienced users. The filmstrip implies that a sort of film or animation will be created. This metaphor encourages common wording between the requirements engineer and the interviewee: "A movie scene (scenario) is created from a series of short clips". Each discussed scenario is represented by one filmstrip and named by the filmstrips label (lower left corner).

The main view shows the currently active element (red selection on the filmstrip). Video or audio clips are played automatically. Images are displayed for a defined amount of time (i.e. 3 seconds). Over each element, there is a layer for pen

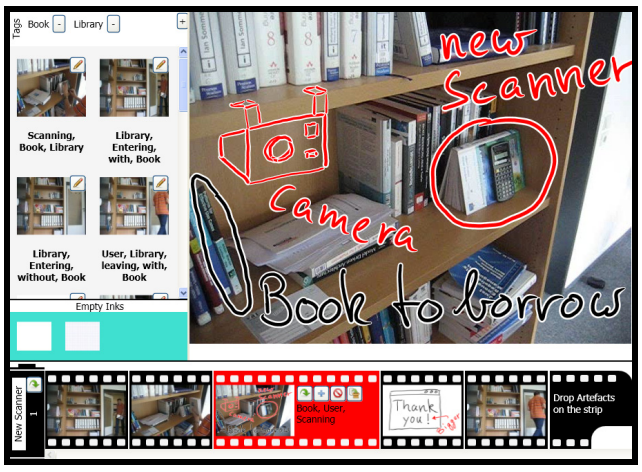

Fig. 1: Interface of the VisionCatcher tool.

input. This allows customization by annotating or highlighting important parts of the element. Requirement can be individually refined and the vision is sharpened. In Fig. 1, one stakeholder drew in a camera. Even drawings from scratch are possible: A special blank element is provided (here, two white boxes placed under the library). In Fig. 1, a "Thank you"-Message was sketched and inserted (fourth scenario step). During the interview, the engineer drags elements from the library and drops them on the filmstrip. Then the elements can be arranged into the needed order. If the desired element cannot be found in the library, the engineer adds a simple sketch or just writes on the blank element. At all times, the VisionVideo can be played and feedback of the interviewee is captured in annotations or by modifying the scenario on the filmstrip (change order, add or remove elements). The interviewee is able to understand each of the engineer's actions and can give direct feedback.

B. *What kind of multimedia?*

The library of multimedia elements grows in the course of using the VisionCatcher tool for requirements engineering in different projects. Each project contributes new multimedia elements. Projects from the same domain may even use the same set of elements as a starting base for discussion. For new and previously unknown domains, the engineer will have at least some understanding of the problem at hand and can prepare videos, photos, or screenshots. Furthermore, legacy systems provide the engineer with already-in-place processes, which can easily documented as multimedia elements and inserted into the VisionCatcher's library. Stakeholders can identify drawbacks of old processes and try to interchange them with better-suited multimedia elements. Visualizing a requirement as a video shows a very concrete situation and helps the stakeholder to concentrate on that.

The stepwise manner in which the VisionVideos are constructed demands for rather short interchangeable actions. Thus, we focus on short videos, which preferably show only one action at a time. Depiction of long processes as video clips are impractical as individual actions cannot be interchanged.

We value correct conveyance of the depicted action over professional appearance of the used video. Professional videos may also be used by our approach; however, high production values are not mandatory. Besides low-effort videos produced by the engineer, we encourage the use of user-generated multimedia feedback, such as discussed in [4, 5, 6, 7]. Instead of special effects, workaround mockups can be used. In Fig. 1, a simple calculator is used to mimic the new scanning system. Professionally pre-produced videos carry one disadvantage: The whole storyline needs to be known in advance. Here, the storyline is constructed and refined in tight collaboration with the stakeholders during the meeting.

III. Story-Board in Action

Generally, we see two main use cases for the VisionCatcher tool. The first use case puts VisionCatcher in a classical meeting with one engineer and several stakeholders where it supports eliciting and validating requirements on the spot. Here, the focus lies on easy elicitation and employment of creative multimedia features in order to support expression of require-

ments. In the second use case, a requirements engineer uses VisionCatcher in an IT-Ecosystem to validate proposed system changes with actual system users. Here, easy and fast validation is directly followed by elicitation of new requirements.

The first use case pictures the VisionCatcher tool in a meeting with stakeholders. The requirements engineer's task is to elicit and validate the vision of the new system. VisionCatcher runs on a tablet PC and is connected to a beamer. This way, all participants are able to see what is happening onscreen. The engineer moderates the meeting and briefly demonstrates the tool. Mainly the engineer will operate the VisionCatcher tool (searching, dragging, dropping elements in right order). All participants will be able to follow his actions onscreen. However, another participant may take over and quickly operate the VisionCatcher tool at any time - for example, for drawing on a multimedia element. At the beginning of the meeting, the engineer asks about important use cases for the new system, prioritizes them, and quickly creates empty VisionVideos (giving each a descriptive name) as placeholders. This way, no mentioned use case is forgotten. Then, the engineer discusses each use case with the participants and selects appropriate multimedia elements from the library. The storyline of the videos are not known beforehand, but are determined together with the present stakeholder.

The second use case enables non-standard RE, which was specifically adapted to the constraints found in ITES. In order to stay competitive, providers of subsystems in ITES strive for continuous improvement of their services and subsystems. However, subsystems in ITES generally serve a vast number of customers. This complicates Quality Management: Which of these customers has valuable new requirements and how can one elicit them? In [4, 5, 6, 7] the approach to focus on user-generated feedback in is proposed. To this end, a special mobile phone application named Contexter is introduced. It enables the users of ITES to send multimedia-enriched feedback to subsystem providers. Feedback can be composed of text messages, videos, and photos or even audio clips – essentially the multimedia technologies in mobile cell phones. The provider identifies problems that need immediate attention. At this point, VisionCatcher can be employed. The provider passes relevant feedback to a requirements engineer. These multimedia elements can be inserted into the library. Potentially, an affected user has sent in a short video-clip of a possible solution to the problem. This could serve as stimulus for finding a suitable solution. The engineer eventually creates a preliminary solution and documents it as a VisionVideo. Not yet existing system parts are represented by cheap mockups. Effort should be kept low, as the proposed solution will be subject to change. Now, the engineer can interview users of the running system. Presenting a video of the service as-is helps to focus an affected user's attention on the problem. For example, one of the sent-in feedback videos could be shown. After that, the engineer can present his new solution and validate it with the user.

IV. Benefits of our Approach

Classical RE activities are located in the early phase of software development. Usually, they are executed in the course of several meetings with stakeholders. VisionCatcher focuses on the situation of ITES, where there may be only one interview with a specific stakeholder. In this case, all of the given RE activities need to be executed in this first meeting. However, VisionCatcher specifically adapts to and supports the following three activities: elicitation and validation benefit the most and a new kind of documentation is delivered.

The main idea is to enable stakeholder involvement and interaction by employing different multimedia technologies for documentation of requirements. Stakeholders easily understand videos and are not required to learn any engineering notations. This supports elicitation in different ways. Visualization of old processes or even misuse cases can be used as a trigger (or help) for elicitation of new requirements. After that, the variety of used multimedia technologies combined with support for annotation enables the engineer to document the new requirements as true to original as possible. The constructed VisionVideo can be watched together with the stakeholder for instant validation. This instant validation in the meeting triggers another round of elicitation: elicitation of change requests. These are then again documented and validated. Attributes of multimedia (such as its specificity) support that. Naturally, in this elicitation-documentation-validation-loop the activities interpretation and negotiation happen as well. However, they are not directly supported by the VisionCatcher tool and happen "in between" and in discussion.

A new kind of multimedia documentation of requirements is produced. Individual annotation on each multimedia element enriches the meaning of the element greatly and sharpens the vision. Requirements can be documented more flexibly and accurately. For capturing rationale, audio recording of the interview is possible. Interesting parts in the recording can be marked. However, no formal documentation is delivered. Our focus lies on complete and true-to-original documentation.

V. Related Work

Research areas of utilizing multimedia in requirements engineering include the following: communicational power of videos compared to textual descriptions, the appropriate effort of video production, and linking multimedia requirements with formal models in order to bridge the gap between requirements engineer and implementing engineer. With the advancements of video capabilities in today's mobile phones, mobile application of requirements engineering becomes more and more important.

Brill et al. [10] compare video representation of requirements to textual use cases and find that low-effort ad-hoc videos help to clarify more requirements than textual use cases under time pressure. Broll et al. [11] argue that the production of professional video material can be uneconomic and time-consuming. The findings of their experiment indicate that amateur class video capturing is sufficient for videos of acceptable quality. This strengthens our approach of using low-effort video material (e.g. by smart phones). We provide a specialized tool to handle a flexible video representation whereas both contributions used normal and plain video clips.

Seyff et al. [12] and Schneider [7] employ videos for finding requirements. Their approaches focus on new and additional requirements for already existing systems by involving users. However, one of our focuses is expression of visions for

not yet existing systems. Zachos and Maiden [13, 14] use their ART SCENE system on mobile devices to guide stakeholders through scenarios. By following those scenarios in concrete and contextualized situations, misunderstandings and invalid assumptions can be detected. This method is used to enrich descriptions of scenarios with rich-media files. This approach uses already existing scenarios and attaches in later stages of the RE process whereas we intent to support the creation of such scenarios in the very beginning of the RE process.

Techniques for analyzing the formal requirement content of a video are proposed by Creighton et al. [15] and Bruegge et al. [16]. They analyze the problem description before they start with the video-based methods. Our method differs, since we construct the storyboard together with the stakeholder during the early phases of the elicitation process. Creighton uses multimedia representation of requirements for construction of formal models like UML sequence diagrams. Mansurov [17] uses interface mockups for describing activity flows and generating UML sequence diagrams. Here, the mockups must be prepared to work with their tool, thus making it difficult to provide fast feedback during an interview. In contrast, our approach does not deliver any formal model but emphasizes on the interaction between the requirements engineer and the stakeholder.

VI. Limitations & Conclusion

When VisionCatcher is used to interview a group of stakeholders, different and deviating visions of one scenario may result. For example, one stakeholder demands a particular order of actions in a VisionVideo, while another wishes to interchange several steps. These deviations are of great value to the engineer, as they uncover hidden requirements. It is the engineer's task to detect, interpret, and negotiate these variations. However, if these deviations arise in the course of different interviews over time, stakeholders may be out of reach for negotiation. Researching an appropriate approach to detect, manage, and harvest such deviations automatically during a stakeholder interview [18, in German] is in progress. Furthermore, Kitzmann [9] conducted a small evaluation of the acceptance and applicability of the VisionCatcher tool (three groups of two, two and four students with different experience levels used either VisionCatcher or textual use cases to describe a visionary bibliotheca system) and found positive results. However, this bears little statistical significance and we intend to evaluate the applicability of VisionCatcher even further.

Our approach focuses on understandability and expressiveness of the communication between requirements engineer and stakeholder. We use multimedia technologies for accurately expressing stakeholder requirements and visions of scenarios. Videos of stakeholder visions are constructed by choosing and concatenating elements from a library of video clips, photos, screenshots, or even audio clips. All of these multimedia elements can be annotated and enriched with sketches. We present two main use cases for our interactive storyboard. Firstly, VisionCatcher improves the classical stakeholder-meeting situation. Stakeholders understand multimedia videos. This motivates the expression of (further) requirements and improves elicitation. Validation *on the spot* is introduced: requirements depicted as videos can be watched, altered, and enriched during the interview. These VisionVideos are a new kind of documentation. Secondly, the engineer uses VisionCatcher for quickly conveying visionary system improvements. This is particularly useful for validating new ideas with affected system users. Interviewed users can quickly grasp the content of the video and request changes. The video is altered accordingly and the engineer validates it on the spot.

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